Fri Feb 28 10:29:22 EST 2020
"Hope, Brian" <Hope.Brian@epa.gov>
FW: Letter and Enclosures Regarding the Final Root Cause Analysis Report and Emissions Report
To: "CMS.OEX" <cms.oex@epa.gov>; "Gaines, Cynthia" <Gaines.Cynthia@epa.gov>

From: Sigmund, Tom <TSigmund@newwater.us>
Sent: Friday, February 28, 2020 9:54 AM
To: Wheeler, Andrew <wheeler.andrew@epa.gov>; Mooney, John <Mooney.John@epa.gov>
Cc: Gross, Louise C <gross.louise@epa.gov>; Bonar-Bridges, James I - DNR <james.bonarbridges@wisconsin.gov>; Tania.Taff@wisconsin.gov; Schaufelberger, Daniel <schaufelberger.daniel@epa.gov>; Hill, Maria A - DNR <maria.hill@wisconsin.gov>; Smies, Jonathan <JSmies@gklaw.com>; ajharrin@gklaw.com
Subject: Letter and Enclosures Regarding the Final Root Cause Analysis Report and Emissions Report

Messrs. Wheeler and Mooney:

Please see the attached letter and enclosures regarding the final Root Cause Analysis Report and Emissions Report for the Green Bay Metropolitan Sewerage District.

Please contact me with any questions.

Regards,

Tom Sigmund | Executive Director

Green Bay Metropolitan Sewerage District

NEW Water
The board of the Green Bay Metropolitan Sewerage District

T: (920) 438-1095 | **E**: tsigmund@newwater.us | **C**: (920) 606-6841 | www.newwater.us

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

February 27, 2020

VIA CERTIFIED MAIL AND
EMAIL TO WHEELER.ANDREW@EPA.GOV AND MOONEY.JOHN@EPA.GOV

Mr. Andrew Wheeler
EPA Administrator
U. S. Environmental Protection Agency
Mail Code 1101A
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Mr. John Mooney
U.S. Environmental Protection Agency
Mail Code A-187
77 West Jackson Boulevard
Chicago, IL 60604-3507

RE: 40 CFR § 60.4861(b) Final Root Cause Analysis and Emissions Report
NEW Water Fluidized Bed Incinerator
Operation Permit No. 405004600-P30
WPDES Permit No. WI-0065251-01-1

Dear Messrs. Wheeler and Mooney:

The Granular Activated Carbon (GAC) has been operational with the fluidized bed incinerator since February 13, 2020. The purpose of this letter is to provide you with a final Root Cause Analysis Report regarding the thermal excursion event experienced by Green Bay Metropolitan Sewerage District ("NEW Water") and actions taken by NEW Water to prevent a reoccurrence of this event in the future. In addition, the letter will describe the emissions associated with the excursion event.

Background Information

On December 31, 2019, NEW Water filed a written report with EPA pursuant to 40 CFR § 60.4861 (the "Malfunction Report"). In addition on the same date, NEW Water filed a request for a 30-day extension to the written report deadline pursuant to 40 CFR sec. 60.4861(b) (the "Extension Request"). Subsequently, on January 3, 2020 NEW Water supplemented the response to 40 CFR § 60.4861(a)(9) with the written root cause analysis based on NEW Water's understanding of the malfunction event at that time (the "Initial Root Cause Report"). A copy of the Malfunction Report, Extension Request, and Initial Root Cause Report are enclosed hereto as Attachment A.

NEW Water retained Chavond-Barry Engineering Corporation ("CBE") as a consultant to provide a complete, independent review of the facts underlying the malfunction event involving the GAC and provide some recommendations to determine, correct, and eliminate the primary causes of the malfunction (the "Engagement"). CBE has completed the Engagement and provided a final report on the findings and

recommendations resulting from the Engagement (the "CBE Report"). A copy of the CBE Report is enclosed hereto as Attachment B.

Overview of the CBE Report

The CBE Report identifies the primary causes of the malfunction and the excess emissions resulting from the malfunction event. Additionally, the report recommends and prioritizes possible actions that may reduce the likelihood of a similar event from occurring in the future and limit the amount of damage that might occur as a result.

It is important to note that the GAC technology will produce exothermic reactions as the carbon adsorbs moisture and contaminants to remove them from the incineration flue gas stream. This makes the operational conditions of the GAC, as well as the protective monitoring systems, important to manage the heat produced by these reactions.

Actions Undertaken by NEW Water to Prevent a Future GAC Malfunction

The actions taken by NEW Water in response to the root cause analysis findings contained in the CBE Report have been focused on addressing the operational conditions and improving the monitoring systems necessary to avoid a future malfunction event (the "Mitigation Actions").

The Mitigation Actions undertaken by NEW Water are summarized, as follows:

Action	Result/Expected Result	Status
Added 27 new carbon bed temperature monitoring points	Early detection of a hot-spot will enable earlier mitigation and protect from extensive damage	Completed and operational
Optimization of upstream venturi scrubber and WESP	Optimize SOx and particulate removal to protect GAC performance and reduce likelihood of need for washing carbon	Scheduled for mid-March
Enhanced protection system interlocks	Eliminate gaps in the protective system controls, resulting in increased alarm and protective functionality, while avoiding nuisance quenching of carbon	Completed and operational
Improved CO monitoring system maintenance practices	Spare parts are now on hand, quarterly preventative maintenance scheduled to improve system up-time and reliability	Completed
Operator training	Increase awareness of GAC control functionality changes, hot-spot identification, response protocols	Completed, will provide refresher training going forward
Post quench/wash response	Dispose of carbon, avoid high-risk conditions in GAC	Decision made, no attempt to dry carbon until modified drying procedure fully developed and evaluated

Evaluate alternative carbon source	Testing and engineering evaluation may indicate decreased hot-spot formation with alternative carbon source(s)	Testing has been completed, evaluation underway

The Engagement and the resulting CBE Report were intended to determine, correct, and eliminate the primary causes of the malfunction event. NEW Water believes that actions taken by NEW Water described in this letter and based upon the CBE Report will serve to significantly reduce, if not eliminate, the occurrence of a similar malfunction event in the future.

Emissions Associated with the GAC Malfunction

NEW Water is subject to two emission limits for mercury under its air operation permit. The first is a mass limit of 3.2 kg (7.1 pounds) per 24-hour period, established under the National Emission Standard for Mercury (40 CFR 61, Subpart E). The second is a concentration limit of 0.0010 milligrams per dry standard cubic meter (mg/dscm), corrected to 7% oxygen, established under the Standards of Performance for New Stationary Sources: Sewage Sludge Incineration Units (40 CFR 60, Subpart LLLL). Attachment C contains a summary of emissions of mercury while incinerating sludge without use of the GAC during the malfunction.

The information contained in this letter and attachments is intended to conclude the reporting requirements associated with the GAC malfunction event. However, NEW Water is open to providing any further information necessary for the agency to consider an appropriate response to this malfunction event. Please feel free to contact me with any further questions on this topic.

Sincerely,

GREEN BAY METROPOLITAN SEWERAGE DISTRICT

The undersigned is the Executive Director of Green Bay Metropolitan Sewerage District, also known as NEW Water, and hereby certifies, based on information and belief formed after reasonable inquiry, the statements and information contained herein are accurate.

Thomas W. Sigmund, P.E.
Executive Director

Enclosures: Attachment A
Attachment B
Attachment C

cc: Louise Gross (gross.louise@epa.gov)
James Bonar-Bridges (james.bonarbridges@wisconsin.gov)
Tania Taff (tania.taff@wisconsin.gov)
Daniel Schaufelberger (schaufelberger.daniel@epa.gov)
Maria Hill (maria.hill@wisconsin.gov)
File

Attachment A
to 2/27/2020 report

NEW Water
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January 3, 2020

VIA CERTIFIED MAIL AND
EMAIL TO WHEELER.ANDREW@EPA.GOV AND MOONEY.JOHN@EPA.GOV

Mr. Andrew Wheeler
EPA Administrator
U. S. Environmental Protection Agency
Mail Code 1101A
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Mr. John Mooney
U.S. Environmental Protection Agency
Mail Code A-187
77 West Jackson Boulevard
Chicago, IL 60604-3507

RE: 40 CFR § 60.4861(b) Supplement to Written Report
NEW Water Fluidized Bed Incinerator
Operation Permit No. 405004600-P30
WPDES Permit No. WI-0065251-01-1

Dear Messrs. Wheeler and Mooney:

On December 31, 2019, Green Bay Metropolitan Sewerage District ("NEW Water") filed a written report with EPA pursuant to 40 CFR § 60.4861 (the "Malfunction Report"). A copy of the Malfunction Report is attached hereto as Attachment A. In addition, on the same date, NEW Water filed a request for a 30-day extension to the written report deadline pursuant to 40 CFR sec. 60.4861(b) ("Extension Request"). A copy of the Extension Request is attached hereto as Attachment B.

In the unlikely event that the Extension Request is not granted by EPA and without waiving its right to receive the same, NEW Water is supplementing the response to 40 CFR § 60.4861(a)(9) in the Malfunction Report with this letter. In particular, this letter serves as the written root cause analysis based on NEW Water's understanding of the malfunction event to date and provides a description of actions taken to complete a more comprehensive report on this topic in the near future.

Affirmative Defense Pursuant to 40 CFR § 60.4861(a)

(9) A written root cause analysis has been prepared the purpose of which is to determine, correct, and eliminate the primary causes of the malfunction and the excess emissions resulting from the malfunction event at issue. The analysis shall also specify, using best monitoring methods and engineering judgment, the amount of excess emissions that were the result of the malfunction.

Green Bay Metropolitan Sewerage District
2231 North Quincy Street | Green Bay, WI 54302 | Phone (920) 432-4893 | Fax (920) 432-4302 |
www.newwater.us

Response:

NEW Water is investigating the cause of the failure as well as the performance of the monitoring and protective systems during the malfunction event. Based upon consultation with industry experts and NEW Water's general understanding of the granular activated carbon ("GAC") technology, NEW Water's current and preliminary understanding of what may be the primary cause of the malfunction is as follows: Carbon bed hotspots commonly form as a result of an exothermic reaction due to moisture or contaminants in the incineration flue gas adsorbing onto the carbon. These hotspots, if not properly cooled with adequate, well-distributed air flow, can reach temperatures that can damage fiberglass components of the GAC system.

In addition, NEW Water has retained Chavond-Barry Engineering Corporation ("CBE") to perform a more comprehensive root cause analysis. NEW Water will provide EPA and DNR with a copy of CBE's findings along with recommendations for possible changes for operational procedures and system monitoring and controls that will correct and eliminate the primary causes of the malfunction ("Final Report"). The Final Report will attempt to clarify the extent to which the following conditions (and potentially others) may have contributed to the development and inability to control the carbon bed hotspot:

- Build-up of deposits in carbon bed;
- Carbon bed washing and drying operations during the maintenance outage; and
- Carbon monoxide and carbon bed temperature monitoring system performance.

With regard to the amount of emissions associated with malfunction that is the subject of the root cause analysis, please see the discussion regarding emissions contained in pages 8-10 of the Malfunction Report.

Of course, if you have any questions about the content of this supplemental letter, please feel free to contact the undersigned at your convenience.

Sincerely,

GREEN BAY METROPOLITAN SEWERAGE DISTRICT

The undersigned is the Executive Director of Green Bay Metropolitan Sewerage District, also known as NEW Water, and hereby certifies, based on information and belief formed after reasonable inquiry, the statements and information contained herein are accurate.

Thomas W. Sigmund, P.E.
Executive Director

Enclosures: Attachment A
Attachment B

cc: Louise Gross (gross.louise@epa.gov)
James Bonar-Bridges (james.bonarbridges@wisconsin.gov)
Tania Taff (tania.taff@wisconsin.gov)
Daniel Schaufelberger (schaufelberger.daniel@epa.gov)
File

NEW Water
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December 31, 2019

VIA CERTIFIED MAIL AND
EMAIL TO WHEELER.ANDREW@EPA.GOV AND MOONEY.JOHN@EPA.GOV
Mr. Andrew Wheeler
EPA Administrator
U.S. Environmental Protection
Agency Mail Code 1101A
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Mr. John Mooney
U.S. Environmental Protection Agency
Mail Code A-187
77 West Jackson Boulevard
Chicago, IL 60604-3507

RE: 40 CFR § 60.4861(b) Written Report
NEW Water Fluidized Bed Incinerator
Operation Permit No. 405004600-P30
WPDES Permit No. WI-0065251-01-1

Dear Messrs. Wheeler and Mooney:

This letter serves as the written report referenced in 40 CFR § 60.4861(b) and demonstrates that the Green Bay Metropolitan Sewerage District ("NEW Water") has met the affirmative defense requirements set forth in 40 CFR § 60.4861(a). Since November 12, 2019, NEW Water has had numerous discussions with U.S. Environmental Protection Agency ("EPA") Region 5 attorneys and staff (including Ms. Louise Gross, Mr. Daniel Schaufelberger, Mr. John Mooney, and Mr. Ethan Chatfield) and with Wisconsin Department of Natural Resources ("DNR") attorneys and staff (including Mr. James Bonar-Bridges, Ms. Kristin Hart, Ms. Maria Hill, and Ms. Tania Taff), regarding a malfunction in connection with NEW Water's Granular Activated Carbon ("GAC") equipment used to control mercury emissions from its fluid bed incinerator ("FBI") and related events. As you are aware, on November 22, 2019, NEW Water provided notice via telephone in accordance with 40 CFR § 60.4861(b) to Mr. John Mooney, Acting Director of EPA Region 5 Air and Radiation Division, of a potential exceedance of its mercury emissions limit on November 21, 2019 during the malfunction. NEW Water also provided a follow-up email regarding the notice to Mr. Mooney and Ms. Louise Gross (see Appendix B).

As discussed in further detail below, NEW Water has made extensive efforts to avoid operating its FBI without the GAC during the malfunction while continuing to provide necessary sewerage treatment services for the public in the metropolitan Green Bay area, a service vital to the basic sanitation needs of area residences and businesses.

This report is intended to meet the requirement to file a written report within 45 days of the initial exceedance on November 21, 2019 in accordance with 40 CFR § 60.4861(b).

While operating the FBI without the GAC might exceed a mercury emission limit, it does not pose a significant risk to the public. NEW Water conducted an air dispersion modeling evaluation using an estimate of the mercury emission rate from the FBI without the GAC. The evaluation demonstrates that the impacts from the emission rate are well within state health-based standards.

Background

NEW Water operates an FBI at its plant located in Green Bay, Wisconsin. The FBI processes biosolids generated at the Green Bay plant as well as the De Pere, Wisconsin plant, which is located about seven miles from the Green Bay plant and is connected with a pipeline. NEW Water commissioned the new, state-of-the-art FBI and the air pollution control system (including the GAC) in May 2018. The FBI, which replaced two old multi-hearth incinerators, was part of a complete solids processing upgrade project that cost more than $170,000,000. NEW Water planned for its first annual maintenance shutdown of the FBI in fall 2019. The shutdown started on October 19, 2019 and was to conclude with all systems back in operation starting on November 7, 2019.

The FBI is subject to the Standards of Performance for New Sewage Sludge Incineration Units under 40 CFR 60 Subpart LLLL ("Subpart LLLL.") Subpart LLLL contains an emission limitation for mercury, 0.0010 milligrams per cubic dry meter (mg/dm^3) corrected to seven percent oxygen (see Table 1 to Subpart LLLL). In addition, NEW Water holds a construction permit (Permit No. 14-JJW-051-R1) and an operation permit (Permit No. 405004600-P30) for the FBI and the emission control systems that include the Subpart LLLL requirements.

In order to meet the Subpart LLLL mercury standard, NEW Water petitioned the EPA to allow the installation of the GAC, which the EPA approved. The GAC uses a specially-formulated activated carbon designed to remove mercury from the FBI exhaust stream. During the initial and subsequent compliance emission tests required under Subpart LLLL, NEW Water has established acceptable operating parameter metrics for the GAC and the other emission control processes on the FBI, including metrics for the applicable mercury limitation.

NEW Water treatment staff observed abnormal temperature and carbon monoxide readings in the GAC during the warm up of the FBI on November 7, 2019. After discovering these abnormal readings, NEW Water staff had extensive communication with Carbon Process & Plant Engineering, S.A. ("CPPE"), the manufacturer of the GAC, about the appropriate action NEW Water should take as part of the startup process. Based upon the GAC manufacturer's recommendations and NEW Water's concern about the potential for a fire in the GAC, NEW Water manually initiated a water quench of the GAC vessel. A subsequent visual inspection revealed damage to internal components of the GAC. NEW Water subsequently began the process of evacuating the GAC of all carbon and performing a full internal inspection. The FBI remained down during the GAC evacuation process.

NEW Water took all appropriate action to order new carbon for the unit as well as replacement grids from the manufacturer and other suppliers. After removal of the carbon, NEW Water discovered extensive damage to the GAC grid units and walls. Upon discovery of the extensive damage and after consultation with the manufacturer, NEW Water ordered additional grid parts.

In addition, NEW Water has made arrangements with a qualified contractor to repair the damaged walls of the GAC. NEW Water is in the process of engaging a qualified expert to undertake a root cause analysis of the malfunction of the GAC.

For the reasons set forth below, NEW Water has been intermittently operating the FBI without the GAC since November 21, 2019. NEW Water currently anticipates that the GAC will be repaired and available for use by mid-January 2020, provided the root cause analysis does not identify any additional actions required to prevent reoccurrence of a malfunction.

Affirmative Defense Pursuant to 40 CFR § 60.4861(a)

(1) The excess emissions:

(i) Were caused by a sudden, infrequent, and unavoidable failure of air pollution control and monitoring equipment, process equipment, or a process to operate in a normal or usual manner

Response:

The excess emissions were caused by a sudden, infrequent, and unavoidable failure of the GAC during the startup of the FBI after a scheduled annual shutdown for inspection and maintenance, which was expected to occur between October 19, 2019 and November 7, 2019.

During the shutdown, NEW Water personnel worked with the designer and manufacturer of the GAC, CPPE, to troubleshoot and resolve an increase in differential pressure observed by NEW Water staff across the carbon bed beginning in late August 2019. NEW Water continuously monitors differential pressure across the carbon bed, which contains three vertical layers. NEW Water's limit for maximum differential pressure across the bed is 11 inches of water. The limit was never exceeded, but the rate of increase indicated that changes were occurring within the unit and further action was warranted in response to the observed change in differential pressure.

Based upon NEW Water's follow-up inspections of the GAC unit during the scheduled shutdown and communication between NEW Water and CPPE, CPPE concluded that sulfur salts had likely built up in at least one of the three carbon layers and recommended that the carbon be washed with water to remove the material to allow air to flow through more freely. NEW Water personnel followed CPPE's written procedure for conducting the carbon wash and communicated closely with CPPE for clarification and guidance throughout the washing.

When the wash was complete, the carbon was wet and required drying before the unit could be put into service, per CPPE's instructions. NEW Water followed CPPE's written procedure for initiating the drying process from October 29 until November 1, 2019.

After NEW Water completed the washing and drying process for the carbon, on November 7, NEW Water treatment personnel commenced the process of the startup of the GAC without sludge in the FBI and observed increasing temperature and carbon monoxide concentrations inside the GAC. After sharing these observations with CPPE, CPPE agreed on November 7 that NEW Water personnel should initiate the built-in quench system to cool the carbon and to attempt to reduce any combustion.

Once the carbon appeared to be controlled (the temperature dropped to the expected level), the GAC was isolated to prevent additional combustion. Inlet and outlet isolation dampers were closed and the GAC was taken out of service. NEW Water continued to flush the adsorber until carbon removal began on November 19.

(ii) Could not have been prevented through careful planning, proper design, or better operation and maintenance practices

Response:

Based on currently available information, NEW Water could not have prevented the excess emissions through careful planning, proper design, or better operation and maintenance practices.

NEW Water made and has continued to make extensive efforts to avoid operating the FBI without the GAC during the malfunction, which efforts are described in more detail in the response to Section 60.4861(a)(3) and Appendix A.

At the time of the startup of the GAC after the washing and drying process was completed, the carbon was well within its recommended useful life range, as discussed in more detail in the response to Section 60.4861(a)(1)(iii), below.

NEW Water closely followed CPPE's recommendations when it washed and dried the carbon and then commenced startup, as discussed in more detail in the response to Section 60.4861(a)(1)(i), above.

NEW Water is in the process of engaging a qualified expert to undertake a root cause analysis of the incident. NEW Water is working with the system manufacturer, designers, vendors, and an independent consultant to review the incident. NEW Water will share the findings of the investigation with the EPA as soon as the findings are available.

Once the cause of the incident is better understood, NEW Water may implement modifications to the system as well as to the operating procedures if the findings support such action.

(iii) Did not stem from any activity or event that could have been foreseen and avoided, or planned for

Response:

Based on information currently available to NEW Water, NEW Water could not have foreseen and avoided, or planned for the excess emissions resulting from the malfunction.

The malfunction occurred while the FBI was being brought online after a scheduled shutdown for inspection and maintenance. The carbon in the unit had been washed and dried according to the manufacturer's written instructions, as described in more detail in the response to Section 60.4861(a)(1)(i), above.

In accordance with information provided by CPPE, NEW Water expected to need replacement of the carbon at the earliest after two to three years of operation. NEW Water's air permit requires site-specific parametric monitoring in accordance with Subpart LLLL. NEW Water followed manufacturer recommendations to establish two methods of parametric monitoring to assess the actual remaining life of the carbon on an ongoing basis, as described in its site specific monitoring plan.

The first parameter is the differential pressure across the adsorber. The upper differential pressure limit, 11 inches of water, was set by the manufacturer based on the maximum gas flow rate through the carbon. The differential pressure is an indication of the buildup of dust, moisture or precipitates, which normally increases slowly over time. NEW Water continuously monitored this parameter when the incinerator combusted sewage sludge, and the differential pressure did not indicate that the carbon was expended.

The second parameter is mercury removal capacity. The manufacturer recommends replacing carbon when the available sulfur content reaches 20% or less of the original sulfur content of the carbon. The total sulfur content of the activated carbon is determined by a certified laboratory. In accordance with the schedule recommended by the manufacturer, the mercury removal capacity for NEW Water's activated carbon was monitored monthly for the first three months to establish saturation behavior of the carbon bed, then every six months. The most recent sampling event took place in May 2019, the results of which showed sulfur content at 77% to 84%, well in excess of CPPE's recommendations for carbon replacement. Samples of the carbon were taken from each of the three vertical carbon layers within the GAC. Thus, the analytical results indicated that the carbon could be used to control mercury emissions for several years.

(iv) Were not part of a recurring pattern indicative of inadequate design, operation, or maintenance

Response:

Based on information currently available to NEW Water, the excess emissions resulting from the malfunction are not part of a recurring pattern indicative of inadequate design, operation, or maintenance.

NEW Water is not aware of any thermal excursions in NEW Water's GAC prior to the November 7 incident.

NEW Water became aware of one isolated incident of a thermal excursion at another FBI installation in Connecticut during construction of the NEW Water FBI. NEW Water installed systems recommended by the manufacturer designed to mitigate such excursions and relied on assurances from the manufacturer that such systems would mitigate such excursions.

(2) Repairs were made as expeditiously as possible when the applicable emission limits were being exceeded. Off-shift and overtime labor were used, to the extent practicable to make these repairs

NEW Water has diligently endeavored to obtain replacement parts and schedule repairs as expeditiously as possible. Such efforts have included contacting multiple suppliers of carbon and contractors to perform the repairs, as described in more detail below. NEW Water has conducted a GAC vessel assessment and developed repair plans to return the GAC to an operable state as soon as possible. Contractors and NEW Water staff have been working and will continue to work extended hours to accommodate repairs.

NEW Water has undertaken the following action items related to the internal GAC vessel damage assessment, repair parts orders, and internal repair efforts after the November 7 incident:

Spent carbon evacuation:

NEW Water applied quench water to the GAC vessel on November 7 to protect and mitigate damage from a potential thermal excursion. The quenching process, once initiated, ran through the weekend. A local contractor arrived on site on November 15 to review and discuss plans for having the spent carbon removed from the GAC.

Spent carbon removal began on November 19, continued through the week, and was completed on November 22. NEW Water staff immediately began the process for inspecting the inside of the GAC vessel.

Replacement carbon:

On November 11, NEW Water contacted the GAC manufacturer regarding the lead time for a full unit replacement of carbon and placed an order for the GAC manufacturer's carbon on November 12. After learning that proprietary carbon from the GAC manufacturer would take weeks to months to arrive from Europe, NEW Water researched domestic suppliers of carbon. NEW Water was ultimately able to procure a similar carbon that meets the specifications for the GAC from a domestic supplier. NEW Water ordered enough carbon to fill the entire unit on November 13 from a supplier in California. A complete supply of carbon from the domestic supplier is now onsite and ready to be placed into the GAC vessel. Additionally, approximately two-thirds of the required carbon from the GAC manufacturer is onsite. A shipment of carbon from the manufacturer containing the remaining carbon is expected to be delivered to NEW Water the first week of January.

GAC Internal Grids:

Three vertical layers of carbon within the GAC are separated by a grid composed of 192 interlocking pieces. On November 8, plant maintenance staff reviewed the internal GAC vessel parts listing to determine what parts may be required. Access hatches were opened on the GAC in an attempt to see what damage occurred. Anticipating that some damage to the grids likely occurred as a result of the thermal excursion, NEW Water ordered an initial set of replacement pieces from the GAC manufacturer in Luxembourg on November 18. After the carbon was removed from the unit, a thorough internal inspection of the GAC allowed NEW Water to fully understand the extent of damage that occurred. The initial order for replacement grid pieces placed on November 18 would not be adequate to repair all of the damage that was discovered during the internal inspection that was completed on November 25. NEW Water placed a second order for needed replacement parts with the GAC manufacturer to ensure that all repairs can

be completed. The parts shipments were shipped from Europe and arrived at NEW Water on December 18. NEW Water reviewed and inspected the parts order immediately after receipt and has confirmed that it is complete.

Internal GAC Walls:

In addition to the grids, the carbon inside the GAC is supported in place by internal fiberglass divider walls. The walls were damaged by the thermal excursion and require repair. NEW Water contacted a local fiberglass contractor on November 26 to schedule an internal inspection. The inspection was completed on November 27. NEW Water had a conference call with the GAC manufacturer and the fiberglass inspector on November 27. The fiberglass contractor ordered repair material that arrived at the contractor office the week of December 9.

NEW Water scheduled the fiberglass repair for December 26, which was the repair contractor's earliest availability.

NEW Water placed calls to three additional fiberglass repair companies within the region to inquire about a quicker repair service date. The three fiberglass repair contractors indicated that their earliest availability would be in January 2020.

NEW Water commenced repair work on December 26 using the local contractor who was already scheduled and had the needed materials in stock. Internal fiberglass repairs were completed on December 27. NEW Water staff completed the GAC vessel internal grid reinstallation on December 29.

(3) The frequency, amount and duration of the excess emissions (including any bypass) were minimized to the maximum extent practicable during periods of such emissions

Response:

NEW Water commissioned the new FBI and the air pollution control system (including the GAC) in May 2018 and planned for its first annual maintenance shutdown of the FBI in fall 2019. NEW Water developed a plan to manage sewage sludge during the planned shutdown. The shutdown started on October 19, 2019 and was scheduled to conclude with all systems back in operation starting on November 7, 2019. During the planned outage, solids generated from the liquids treatment side of NEW Water's two treatment plants (the Green Bay Facility and the De Pere Facility) would be managed by building solids inventory in the biological treatment system, storing solids in available aeration basins, and by disposing of some sludge in a regional landfill. This approach was developed to minimize landfill hauling, maintain stability within the biological aspects of the facilities, and control operating expenses. This processing approach, which removed from the system only about half of the sludge that is typically necessary, was effective throughout the duration of the original planned outage. NEW Water cannot shut down its wastewater treatment process during any time because it provides a necessary service for the public.

During the warm up of the FBI on November 7, 2019 in preparation to return to normal operation, NEW Water treatment staff observed abnormal temperature and carbon monoxide readings from on-line instrumentation. In coordination with the GAC manufacturer, CPPE, NEW Water began an investigation into the abnormal readings. Based upon concerns over the potential for a fire in the GAC, NEW Water manually initiated a water quench of the GAC vessel. An initial, limited visual inspection revealed damage to internal components of the GAC, and NEW Water began the process of evacuating the GAC of all carbon and performing a full internal inspection. The FBI remained down during the GAC evacuation process.

With the solids processing system of both treatment facilities affected since October 19, 2019 and the ability to dispose of solids from the system in the normal fashion (incineration) now significantly delayed because of the damage to the GAC, NEW Water became increasingly concerned about the long-term health of the biology of both treatment facilities. NEW Water took steps to temporarily utilize treatment plant capacity for short-term solids storage in standby aeration basins while securing additional landfill space in regional landfills.

As further described in Appendix A, NEW Water has worked with landfills and sludge-hauling contractors to secure approvals for acceptance of its sludge in landfills in Wisconsin. The two primary private landfill operators in Wisconsin are Waste Management and Advanced Disposal. Waste Management has agreed to accept sludge at three of its landfills and Advanced Disposal has agreed to accept sludge at two of its landfills in the state. NEW Water's regional municipal landfill in Outagamie County has also agreed to accept limited amounts of sludge.

Landfills can accept only limited amounts of sludge for a few reasons: (1) the sludge is a challenging consistency to work with, as it is thick and sticky and needs to be placed carefully so heavy equipment does not sink into it and become stuck, and it requires special handling at the landfill to ensure that it does not cause problems for operations; (2) landfill regulations limit how much "wet waste" landfills can accept and stay in compliance with their permits (sewage sludge is considered "wet waste"); and (3) landfills are not open 24/7 and have limited operating hours on weekends and holidays.
NEW Water is not able to incinerate and landfill sludge at the same time. When landfilling takes place, sludge is pumped from the dewatering process and deposited on the floor of a storage building designed for this purpose.

Front end loaders load the sludge from the floor to dump trucks, which then transport the sludge to landfills for disposal. The pumping equipment cannot remove all of the sludge that is produced from the treatment process. NEW Water has secured landfill approvals for all the sludge that can be pumped out of the treatment process during weekdays. Due to the limitations of the pumping equipment, more sludge builds up in the treatment plant than can be shipped offsite for disposal or storage.

Concerned about how the biological systems would withstand the volumes of sludge that were building up within the treatment process, NEW Water consulted with a nationally-recognized expert in wastewater treatment optimization and control on November 20, 2019. The expert consultant reviewed the overall plant condition and discussed observations with staff. This consultant confirmed staff's assessment that the health of the treatment plant was already showing symptoms of distress, which would worsen if sludge continued to build up in the plant. Removal of primary sludge and wasting of activated sludge from the wastewater process is critical to manage operations within final clarification design parameters and to maintain healthy microbiological conditions in the activated sludge system. Ongoing sludge build up in the plant would eventually lead to the inability to maintain the solids in the process and significant discharges of suspended solids and other pollutants in the system effluent would reach the Fox River. Given that microbiological conditions in the wastewater system occur slowly, recovery time from such an event would put adequate treatment at risk for some time.

Thus, in order to protect the health of the treatment processes and continue to treat wastewater, NEW Water started up the FBI intermittently on November 21, 2019, bypassing the GAC system due to the following circumstances: (1) NEW Water's inability to adequately process the De Pere and Green Bay wastewater solids because of landfill and hauler scheduling associated with the Thanksgiving holiday (see Appendix A for more detail); (2) no further capacity to store solids in available tanks; (3) the extended outage of the GAC due to damage to the panels; and (4) the growing concerns over the biological treatment system. The key factor in the decision to operate the FBI without the GAC was the significant concern about the health of the Green Bay Facility liquids treatment, as the continued operation of the wastewater system without the removal of solids would likely lead to extended periods of degraded treatment system performance.

In order to minimize any excess mercury emissions, NEW Water has limited incineration to processing only enough sludge to ensure that significant damage is not caused to the treatment system (i.e., no sludge is added to the existing volumes stored within the plant).

NEW Water currently anticipates that the GAC will be repaired and available for use by mid-January 2020. NEW Water completed a temporary solids processing plan on December 5, 2019 to be implemented while the GAC is being repaired.

The processing plan includes some incinerator operations and significant landfilling of sludge. This operating plan is intended to (1) protect the biology in the liquids treatment system at the Green Bay and De Pere Facilities by maximizing landfill disposal; (2) minimize the air emission impacts associated with operating without the GAC; and (3) protect the FBI refractory from damage associated with temperature cycling.

The processing plan is estimated to reduce the amount of solids incinerated without the GAC by more than 40%; however, the plan is subject to influences outside of NEW Water's ability to control including hauling and landfill availability.

The processing plan also includes NEW Water's need to return to a stand-by state two Green Bay Facility aeration basins, which were temporarily repurposed for sludge storage. The solids that accumulated in these aeration basins reduce the available Green Bay Facility aeration basin capacity by 42 to 48 million gallons per day of treatment, which is an approximate 25% to 30% reduction in available capacity. This additional capacity is needed for treatment of the community's wastewater flow during significant rain and snow melting events, as there have been a number of significant rain events over the past several years that have resulted in the need to utilize this aeration capacity, including during the winter season.

Since implementing the temporary solids processing plan, NEW Water has begun taking steps to return the aeration basins to stand-by status due to the potential for significant wet weather treatment needs and urgency to remove the heavy solids in the basins before the sludge begins to freeze as a result of low temperatures.

Please see Appendix A for a summary of steps taken to avoid operating the FBI without the GAC and the schedule for landfilling and incinerator operations.

(4) If the excess emissions resulted from a bypass of control equipment or a process, then the bypass was unavoidable to prevent loss of life, personal injury, or severe property damage

The bypass of the GAC was necessary to avoid severe property damage (i.e., treatment plant upsets and adverse environmental impacts) resulting from the inability to adequately remove solids from the biological treatment system. NEW Water has developed an approach to landfill as much solids as possible, store some solids in the treatment plant processes, and incinerate the remaining amount of solids, as described in more detail in the response to Section 60.4861(a)(3), above. In addition, during the time the FBI is operated without the GAC, the system has other control technology in operation. That technology has been operated in compliance with parametric requirements in the air permit during all times of operation without the GAC. This approach minimizes the amount of solids incinerated and, therefore, minimizes uncontrolled mercury emissions.

(5) All possible steps were taken to minimize the impact of the excess emissions on ambient air quality, the environment and human health

NEW Water has taken the following steps to minimize the impact of emissions:

1) As described in more detail in the response to Section 60.4861(a)(1)(iv), above, NEW Water has made extensive efforts to repair and restore the operation of the GAC in a safe and expedited manner. NEW Water's efforts have limited the amount of time the FBI has operated without the GAC.

2) NEW Water has made, and continues to make, considerable efforts to minimize the amount of sludge processed without the GAC in operation, as discussed in more detail in the response to Section 60.4861(a)(3), above, and Appendix A.

3) When NEW Water operates the FBI without the GAC, all other pollution control systems are operated in accordance with their required operating ranges. This step ensures a high level of emission control without the GAC.

On December 12, 2019, NEW Water conducted an emission test on FBI emissions without the GAC. The results of the testing will be provided to EPA when available.

In the interim, NEW Water has assessed the potential impacts of the FBI emissions without the GAC based on mercury emissions testing conducted on November 2, 2018 ("November 2018 Test"). During the November 2018 Test, mercury emissions were measured in the FBI exhaust upstream of the GAC. Therefore, the results of this test estimate the emission rate without the GAC operating.

The measured mercury emission concentration from the November 2018 Test was 0.00787 milligrams per cubic meter (mg/m^3) corrected to 7% oxygen. While this emission concentration exceeds the Subpart LLLL emission limit, it meets several other standards, including the Subpart LLLL limit for new multiple hearth sewage sludge incinerators and existing fluid bed and multiple hearth sewage sludge incinerators (see 40 CFR 60 Subpart MMMM).

The measured mercury emission rate from the November 2018 Test was 0.000262 pounds per hour (lb/hr), which meets the National Emission Standard for Mercury (see 40 CFR 61 Subpart E). This emission rate also meets Wisconsin's air toxics emissions standards for mercury (see Wis. Admin. Code § NR 445, Table A). Table 1, below, compares the measured emission rate without the GAC in operation with each of these federal and state standards.

Table 1 Comparison of Estimated Mercury Emission Rate without GAC with Federal and State Standards

Regulation	Numeric Standard	Equivalent Hourly Standard	NEW Water FBI without GAC[1]	Meets Standard, Percent
Federal Standards				
Subpart LLLL New Fluid Bed Incinerator	0.0010 mg/m^3 @ 7% O_2		0.00787 mg/m^3 @ 7% O_2	Exceeds Standard
Subpart LLLL New Multiple Hearth Incinerator	0.15 mg/m^3 @ 7% O_2		0.00787 mg/m^3 @ 7% O_2	5 %
Subpart MMMM Existing Fluid Bed Incinerator	0.037 mg/m^3 @ 7% O_2		0.00787 mg/m^3 @ 7% O_2	21 %
Subpart MMMM Existing Multiple Hearth Incinerator	0.28 mg/m^3 @ 7% O_2		0.00787 mg/m^3 @ 7% O_2	3 %
40 CFR 61 Subpart E Sludge Incineration Plants	7.1 lb/24-hr	0.30 lb/hr	0.000262 lb/hr	0.09 %
Wisconsin State Standards				
NR 446.20(2) Sludge Incineration Plants	7.1 lb/24-hr	0.30 lb/hr	0.000262 lb/hr	0.09 %
NR 445 Table A for Stack Ht > 75 ft Mercury, Inorganic	1,838 lb/yr	0.21 lb/hr	0.000262 lb/hr	0.1 %
NR 445 Table A for Stack Ht > 75 ft Mercury, Inorganic	0.0405 lb/hr		0.000262 lb/hr	0.6 %

To estimate potential impacts on human health from operating the FBI without the GAC, NEW Water conducted air dispersion modeling and compared those potential impacts with state health-based standards. The ambient air quality standards for mercury are shown in the Wisconsin Administrative Code, NR 445, Table A.

[1] The emission rate and emission concentration shown on this table are based on emission testing conducted at the NEW Water Facility on November 2, 2018. The sampling location was upstream of the GAC, so the results estimate emissions without the GAC in operation.

These standards are a 24-hour average[2] concentration of 0.6 micrograms per cubic meter (µg/m³) and an annual[3] average concentration of 0.3 µg/m³. The air dispersion modeling was conducted in accordance with *Wisconsin Air Dispersion Modeling Guidelines* and the federal *Guideline on Air Quality Models* (40 CFR 51 Appendix W).

For evaluation of the 24-hour standard, the actual days the FBI has run without the GAC and is anticipated to run without the GAC (November 21, 2019 through January 31, 2020) were modeled using the 0.000262 lb/hr mercury emission rate. The resulting highest impact, 0.00068 µg/m³ is about 0.1% of the 24-hour standard.

For the annual standard analysis, the FBI was modeled as "off" for the shutdown period (October 19, 2019 through November 20, 2019), "on" at 0.000262 lb/hr during the actual days when the FBI operated or is anticipated to operate without the GAC (intermittently from November 21, 2019 through January 31, 2020), and then "on" at the permitted mercury concentration rate for the remainder of the 365 day period (February 1 through October 18, 2020). The resulting impact, 0.00002 µg/m³ is about 0.007% of the annual standard.

Table 2 – Modeling Results Compared with Ambient Air Standards for Mercury

Averaging Period	Modeled Concentration (µg/m³)	Ambient Standard (µg/m³)	*% of Standard*
24-hr	0.00068	*0.6*	*0.1%*
Annual	0.00002	*0.3*	*0.007%*

As mentioned at the beginning of this letter, while operating the FBI without the GAC might exceed a mercury emission limit, it does not pose a significant risk to the public. The air dispersion modeling evaluation demonstrates that the impacts from the emission rate are well within state health-based standards.

(6) All emissions monitoring and control systems were kept in operation if at all possible consistent with safety and good air pollution control practices

Response:

All monitoring and pollution control systems, including the FBI combustion chamber temperature, the wet scrubber, and the wet electrostatic precipitator, have operated (and will remain in operation) at all times when incineration of sewage sludge has occurred. The Continuous Emissions Monitoring ("CEM") system, which monitors and records emissions of carbon monoxide, has also remained in operation at all times the incinerator has operated.

All operating parameters required for compliance will continue to be monitored and recorded during this time as required by NEW Water's Air Operation Permit. Control systems for operating the incinerator will still remain operational with all safeguards in place for automatic control and safety interlocks.

(7) All of the actions in response to the excess emissions were documented by properly signed, contemporaneous operating logs

Response:

[2] Wisconsin's 24-hour standard is 2.4% of the mercury TLV the American Conference of Governmental Industrial Hygienists.

[3] Reference Concentration for Inhalation Exposure for mercury from EPA Integrated Risk Information System.

NEW Water will continue to operate the CEMS and monitor and record operating data as well as related pertinent information on the status of the incineration system.

NEW Water will continue to provide progress updates on the repair of the GAC to the EPA and the DNR.

(8) At all times, the affected facility was operated in a manner consistent with good practices for minimizing emissions

Response:

Please see the responses to Section 60.4861(a)(3) and (a)(5), above, for discussions regarding how NEW Water operated the facility in a manner consistent with good practices for minimizing emissions. Although not requested by the EPA or the DNR, NEW Water decided to initiate a stack test to analyze mercury emissions from the FBI operating without the GAC to determine actual mercury emissions during the period of malfunction. Air emissions testing for mercury was conducted on December 12, 2019. Results are expected in early January 2020. At the request of DNR, NEW Water has also conducted weekly analysis for mercury in its sewage sludge since the week of December 1, 2019.

NEW Water paired the stack test with samples from the sludge obtained during the stack test. This pairing will provide information about mercury that was in the sludge during emissions testing.

(9) A written root cause analysis has been prepared the purpose of which is to determine, correct, and eliminate the primary causes of the malfunction and the excess emissions resulting from the malfunction event at issue. The analysis shall also specify, using best monitoring methods and engineering judgment, the amount of excess emissions that were the result of the malfunction.

Response:

NEW Water is investigating the cause of the failure as well as the performance of the monitoring and protective systems during the event. NEW Water is in the process of assembling the appropriate team, including an independent third party, to conduct a formal root cause analysis. NEW Water will provide detailed written findings of the root cause analysis to EPA and DNR upon completion along with the amount of excess emissions resulting from the malfunction.

Sincerely,

GREEN BAY METROPOLITAN SEWERAGE DISTRICT

Thomas W. Sigmund, P.E.
Executive Director

Enclosures: Appendix A
Appendix B

cc: Louise Gross (gross.louise@epa.gov)
James Bonar-Bridges (james.bonarbridges@wisconsin.gov)
Tania Taff (tania.taff@wisconsin.gov)
Daniel Schaufelberger (schaufelberger.daniel@epa.gov)
File

APPENDIX A

Summary of Steps Taken to Avoid Operating the FBI without the GAC prior to 11.21.19 and Schedule for Landfilling and Incinerator Operations

1. Actions Taken to Avoid FBI Operation

Action	Alternative	Comment
Evaluate Alternative Disposal Options	Sludge Hauled to Outagamie County Landfill (Appleton, WI) (OC)	Hauled sludge
	Sludge Hauled to Mallard Ridge Landfill (Delavan, WI) (ADS)	Hauled sludge
	Sludge Hauled to Cranberry Creek Landfill (Wisconsin Rapids, WI) (ADS)	Hauled sludge
	Sludge Hauled to Pheasant Run Landfill (Bristol, WI) (WM)	Hauled sludge
	Sludge Hauled to Metro Landfill (Franklin, WI) (WM)	Hauled sludge
	Sludge Hauled to Orchard Ridge Landfill (Menominee Falls, WI) (WM)	Hauled sludge
	Contacted Waste Management (via third party-Full Service Organics, LLC (FSO) Management)	Seeking landfilling opportunities at regional Waste Management (WM) landfills
	Contacted Outagamie County	Seeking landfilling opportunities at Outagamie County (OC) landfill
	Contacted Advanced Disposal (via third party-Veolia)	Seeking landfilling opportunities at regional Advanced Disposal (ADS) landfills
	Contacted FSO Management	Seeking consulting services for landfill options.
	Contacted regional municipal wastewater treatment facilities	Seeking options or suggestions for temporary storage of sludge or disposal outlets.
	Contacted WDNR biosolids management engineer	Seeking options or suggestions for temporary storage of sludge or disposal outlets.
	Contacted Covanta	Seeking disposal options for sludge. Covanta was not able to manage sludge.
	Contacted Veolia	Seeking sludge disposal option at hazardous waste facilities. Veolia will not accept sludge.
	Contacted Stericycle	Seeking sludge disposal option at hazardous waste facilities. Stericycle will not accept sludge.
	Contacted Clean Harbors	Seeking sludge disposal option (or other options). Clean Harbors will not manage sludge.

Evaluated Storage Options - De Pere	Clarifier (2)	Not available. Concern over managing system solids with critical equipment repurposed
	Second Stage Aeration Basins	Not available. Piping modifications required
	Sludge Storage Tank	Not available. Decommissioning of the system already started
	Sludge Building	Not available. Decommissioning of the system already started
	Belt Filter Press Startup	Not available. Decommissioning of the system already started
Evaluate Storage Options - Green Bay	Phosphorus Release Filtrate Tanks	0.39 million gallons of available storage. Utilize storage
	Gravity Thickeners	Not available. Decommissioning of the system already started
	Primary Clarifiers (2)	Not available. Concern over managing system solids with critical equipment repurposed
	South Plant Secondary Clarifiers	Not available. Concern over managing system solids with critical equipment repurposed
	Temporary Open Air Storage Containers	Not available. Offsite odors, outdoor container placement and material handling issues
	Down Aeration Basins	Utilizing South Plant #1. Utilizing North Plant #4
Other Considerations	Ordered replacement carbon from manufacturer	2 to 6 weeks lead time. Order placed
	Inquired for carbon replacement - United States and Canada providers	Alternative identified. Order placed
	Evaluated alternative technologies for mercury removal	Contacted vendors. Mercury removal performance not able to meet Subpart LLLL
	Reduced acceptance of high strength waste	Concern over impact on digesters. Need to feed Waste Activated Sludge to the digesters. Small reduction requested
	Ordered replacement GAC grids (2 orders placed)	2 to 3 weeks lead time even with air freight. Orders placed

2. Schedule for Landfilling and Incinerator Operations

Month	Day	Incinerator Operated	Landfilling	Notes
Actual Incinerator Operation and Landfilling:				
November	8	Off	6 Truckloads	
	9	Off		
	10	Off		
	11	Off	6 Truckloads	
	12	Off	5 Truckloads	
	13	Off	6 Truckloads	
	14	Off	10 Truckloads	
	15	Off	9 Truckloads	
	16	Off	2 Truckloads	
	17	Off		
	18	Off	11 Truckloads	
	19	Off	10 Truckloads	
	20	Off	9 Truckloads	
	21	On	6 Truckloads	
	22	On		
	23	Off		
	24	On		
	25	On		
	26	On		
	27	On		
	28	Off		
	29	On		
	30	On		

December	1	On		
	2	On		
	3	**Off**		
	4	On		
	5	On		
	6	On	9 Truckloads	
	7	On		
	8	**Off**		
	9	**Off**	8 Truckloads	
	10	**Off**	9 Truckloads	
	11	On	8 Truckloads	
	12	On		
	13	On		
	14	**Off**		
	15	**Off**		
	16	**Off**	10 Truckloads	
	17	**Off**	10 Truckloads	
	18	**Off**	10 Truckloads	
	19	**Off**	10 Truckloads	
	20	On	5 Truckloads	
	21	On		
	22	**Off**		
	23	**Off**	10 Truckloads	
	24	**Off**	9 Truckloads	
	25	**Off**		
Anticipated Schedule:				
December	26	On		2
	27	On		2
	28	On		3
	29	**Off**		
	30	**Off**	10 Truckloads	
	31	**Off**	10 Truckloads	

January	1	On		
	2	On		2
	3	On		2
	4	On		3
	5	**Off**		
	6	**Off**	10 Truckloads	
	7	**Off**	10 Truckloads	
	8	**Off**	10 Truckloads	
	9	**Off**	10 Truckloads	
	10	On	10 Truckloads	
	11	On		4
	12	On		1
	13	**Off**	10 Truckloads	
	14	**Off**	10 Truckloads	
	15	**Off**	10 Truckloads	
	16	**Off**	10 Truckloads	
	17	On		
	18	On		4
	19	On		1
	20	**Off**	10 Truckloads	
	21	**Off**	10 Truckloads	
	22	**Off**	10 Truckloads	
	23	**Off**	10 Truckloads	
	24	On		
	25	On		4
	26	On		1
	27	**Off**	10 Truckloads	
	28	**Off**	10 Truckloads	
	29	**Off**	10 Truckloads	
	30	**Off**	10 Truckloads	
	31	On		

Notes:

1. FBI shutdown. Begin sending sludge to the off-loading building in preparation for landfilling following day.
2. Landfill is available on these days. Plan to run FBI to not cycle the FBI and to protect refractory.
3. Estimated shutdown time. Actual shutdown time will be based on sludge holding tank inventory.
4. Landfill is available until 1200 hours. Plan to run FBI to not cycle the FBI and to protect

APPENDIX B
Email Regarding Notice in Accordance with 40 CFR § 60.4861(b)

From: Harrington, Arthur
Sent: Friday, November 22, 2019 3:25 PM
To: Mooney.john@Epa.gov
Cc: harris.michael@epa.gov; Gross, Louise C; Schaufelberger, Daniel; Bonar-Bridges, James I - DNR; maria.hill@wisconsin.govt; Schenck, Sarah
Subject: Confirmation of Malfunction Notification [GK-Active.FID24093]

Dear Mr. Mooney:

I wanted to use this opportunity to confirm our call today at approximately 9:30 a.m.:

Participating for NEW Water (Green Bay Metropolitan Sewerage District) were:

- Tom Sigmund, Executive Director
- Nathan Qualls, Director of Technical Services
- Julie Maas, Environmental Compliance Specialists
- Art Harrington and Sarah Schenck, Godfrey & Kahn, S.C., attorneys for NEW Water

During the call, we provided you with the following information:

- The client's facility is located at 2231 North Quincy Street, Green Bay, Wisconsin
- The facility holds Operation Permit No. 405004600-P30
- The purpose of the telephone notification was to provide you with notice pursuant to 40 CFR Sec. 60.4861 regarding a malfunction
- As we discussed, we have been in contact with DNR and Ethan Chatfield at EPA since November 12th and Louise Gross and Daniel Schaefelberger of Region 5 since November 13th about events leading up to the need for this notification

Please confirm that you are an "authorized representative" for the Administrator, as defined in 40 CFR Sec. 60.2, for the telephone notification required under 40 CFR Sec. 60.4861(b).

Best regards,

Arthur Harrington | *Attorney*
414.287.9414 direct
aiharrin@gklaw.com

GODFREY & KAHN, S.C.
833 E. Michigan Street, Suite 1800 | Milwaukee, Wisconsin 53202-5615

From: Harrington, Arthur
Sent: Monday, November 25, 2019 4:49 PM
To: Gross, Louise C; Mooney, John
Cc: Schaufelberger, Daniel; Bonar-Bridges, James I - DNR; maria.hill@wisconsin.govt; Schenck, Sarah; Witte, Edward
Subject: RE: Confirmation of Malfunction Notification [GK-Active.FID24093]

Thank you, Louise. Your e-mail clarification is much appreciated and understood.

Best wishes, as well, to you and the rest of the DNR/EPA teams for a Happy Thanksgiving holiday.

Best regards,

Art

Arthur Harrington | *Attorney*
414.287.9414 direct | aharrin@gklaw.com
GODFREY & KAHN, S.C.

From: Gross, Louise C <gross.louise@epa.gov>
Sent: Monday, November 25, 2019 4:39 PM
To: Harrington, Arthur <ajharrin@gklaw.com>; Mooney, John <Mooney.John@epa.gov>
Cc: Schaufelberger, Daniel <schaufelberger.daniel@epa.gov>; Bonar-Bridges, James I - DNR <james.bonarbridges@wisconsin.gov>; maria.hill@wisconsin.govt; Schenck, Sarah <SSchenck@gklaw.com>; Witte, Edward <nwitte@gklaw.com>
Subject: RE: Confirmation of Malfunction Notification [GK-Active.FID24093]

Art,

To be clear, although I believe that the Region 5 Air Division Director is an appropriate recipient of the notification prescribed by 40 C.F.R. § 60.4861, that regulatory provision applies solely to the establishment of "an affirmative defense for exceedance of an emission limit or standard during malfunction." Furthermore, such a defense is available in the context of "a claim for civil penalties for exceedances of emission limits that are caused by malfunction…." To date, EPA has not brought such a claim. Nor has EPA agreed that the facts in the New Water situation, as EPA currently understands them, constitute a "malfunction," as defined in 40 C.F.R. § 60.2.

That being said, EPA may nonetheless consider the nine factors listed in 40 C.F.R. § 60.4861(a)—among others—in the context of deciding how to proceed in an particular enforcement matter. This is a decision we will be in a better position to make in the New Water case once we receive comprehensive information about the underlying facts surrounding its decision to run the incinerator without the carbon adsorption system, and its proposed schedule for coming into compliance with the applicable requirements of 40 C.F.R. Part 60, Subpart LLL.

If you have any further questions about this matter before the Thanksgiving holiday, I can be reached in the office on Wednesday.

Louise

Louise C. Gross
Associate Regional Counsel
U. S. Environmental Protection Agency
77 W. Jackson Blvd. (C-14J)
Chicago, IL 60604
(312) 886-6844

From: Harrington, Arthur <aharrington@gklaw.com>
Sent: Friday, November 22, 2019 3:25 PM
To: Mooney, John <[redacted]>
Cc: Harris, Michael <harris.michael@epa.gov>; Gross, Louise C <gross.louise@epa.gov>; Schaufelberger, Daniel <schaufelberger.daniel@epa.gov>; Bonar Bridges, James F - DNR <james.bonarbridges@wisconsin.gov>; [redacted]; Schenck, Sarah <sschenck@gklaw.com>
Subject: Confirmation of Malfunction Notification [GK Active #3024093]

Dear Mr. Mooney:

I wanted to use this opportunity to confirm our call today at approximately 9:30 a.m.:

Participating for NEW Water (Green Bay Metropolitan Sewerage District) were:

- Tom Sigmund, Executive Director
- Nathan Dueth, Director of Technical Services
- Julie Maas, Environmental Compliance Specialists
- Art Harrington and Sarah Schenck, Godfrey & Kahn, S.C., attorneys for NEW Water

During the call, we provided you with the following information:

- The client's facility is located at 2231 North Quincy Street, Green Bay, Wisconsin
- The facility holds Operation Permit No. 40500346000 P30
- The purpose of the telephone notification was to provide you with notice pursuant to 40 CFR Sec. 60.4861 regarding a malfunction
- As we discussed, we have been in contact with DNR and Ethan Chatfield at EPA since November 12th and Louise Gross and Daniel Schaefelberger of Region 5 since November 13th about events leading up to the need for this notification

Please confirm that you are an "authorized representative" for the Administrator, as defined in 40 CFR Sec. 60.2, for the telephone notification required under 40 CFR Sec. 60.4861(b).

Best regards,

Arthur Harrington | *Attorney*
414.287.9414 direct
[redacted]
GODFREY & KAHN, S.C.
833 E. Michigan Street, Suite 1800 | Milwaukee, Wisconsin 53202-5615

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

December 31, 2019

VIA CERTIFIED MAIL AND
EMAIL TO WHEELER.ANDREW@EPA.GOV AND MOONEY.JOHN@EPA.GOV
Mr. Andrew Wheeler
EPA Administrator
U. S. Environmental Protection Agency
Mail Code 1101A
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Mr. John Mooney
U.S. Environmental Protection Agency
Mail Code A-187
77 West Jackson Boulevard
Chicago, IL 60604-3507

RE: Request for 30 day Extension Pursuant to 40 CFR § 60.4861(b)

Dear Messrs. Wheeler and Mooney:

The purpose of this letter is to provide a written request for a 30 day extension on the deadline for the root cause analysis report, one of the nine factors required to be included in the 45 day malfunction report required by 40 CFR § 60.4861(b) to establish an affirmative defense for an exceedance violation of the standard applicable to NEW Water's fluidized bed incinerator. See 40 CFR 60 Subpart LLLL. The basis for this extension request includes the following:

1) On December 31, 2019, Green Bay Metropolitan Sewerage District (also known as NEW Water) filed a Malfunction Report (the "Malfunction Report") with the Administrator. A copy of the Report is attached.

2) The Malfunction Report was necessary as a result of an emission limit exceedance which occurred on November 21, 2019 and was caused by a malfunction.

3) The 45 day period for filing the Malfunction Report will expire on January 6, 2020.

4) One of the requirements which must be addressed in the Malfunction Report is the preparation of a written root cause analysis for the malfunction. See 40 CFR § 60.4861(a)(9).

5) As described in the Malfunction Report, the circumstances giving rise to the malfunction in the Granulated Activated Carbon ("GAC") unit are very complex.

6) NEW Water has used its best efforts to repair the damage to the GAC caused by the malfunction and is in the process of retaining a qualified expert to undertake a root cause analysis required by 40 CFR § 60.4861(a)(9). However, given the unique characteristics of the GAC and the complexities underlying the malfunction which is the subject of the Malfunction Report, it was not possible to retain a qualified expert and provide the written report for the root cause analysis within the 45 days required under 40 CFR § 60.4861.

7) NEW Water requires an additional 30 days to prepare the Root Cause Analysis under the unique and complex circumstances of this case.

8) The request for a 30 day extension has been filed prior to the expiration of the 45 day period applicable to the filing of the Malfunction Report.

For all of these reasons, NEW Water is respectfully requesting a 30 day extension for filing the Root Cause Analysis up to and including February 4, 2020 pursuant to 40 CFR § 60.4861(b).
Your prompt response to this written request for the 30 day extension would be greatly appreciated.
Sincerely,

GREEN BAY METROPOLITAN
SEWERAGE DISTRICT

Thomas W. Sigmund, P.E.
Executive Director

Enclosure

cc: Louise Gross (gross.louise@epa.gov)
James Bonar-Bridges (james.bonarbridges@wisconsin.gov)
Tania Taff (tania.taff@wisconsin.gov)
Daniel Schaufelberger (schaufelberger.daniel@epa.gov)
file

21671793.2

Attachment B
to 2/27/2020 report

NEW Water

Green Bay, WI

November 7, 2019 GAC Adsorber Thermal Excursion Root Cause Analysis Report

Presented by: Chavond-Barry Engineering Corp.

"PRIVILEGED AND CONFIDENTIAL COMMUNICATION"

Prepared By: John Yu
Checked By: LB, AH

Revision 0

Feb. 25, 2020

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OBJECTIVE

The fluidized bed incineration system of NEW Water utilizes a Granular Activated Carbon (GAC) adsorber manufactured by Carbon Process and Plant Engineering S.A. (CPPE) for flue gas mercury control. The adsorber experienced a thermal excursion event on November 7, 2019 after a preventive maintenance shutdown and washing cycle. The thermal excursion caused significant damage to the internals of the vessel which have since been repaired. NEW Water is looking to determine the root cause of the thermal excursion event in order to minimize the potential of a future event. This report looks into the possible cause(s) of the thermal excursion and potential actions that could reduce the possibility of a future thermal excursion event.

KNOWN FACTORS

1. The thermal excursion event occurred on early morning of Thursday November 7, 2019 after a preventive maintenance shutdown. During the preventive maintenance period, the adsorber was washed down to clean the carbon and reduce the high pressure drop caused by the formation of white crystals on the carbon bed. NEW Water communicated closely with CPPE during this time. After wash down, the unit was partially dried (first two carbon layer's moisture was less than 2% and the third layer of carbon had a moisture of greater than 35%) prior to being shut down and isolated with inlet and outlet valves closed on November 1st. The thermal excursion started when the system was being restarted after the shutdown period. During the shutdown period, the adsorber's carbon monoxide (CO) monitor detected increased CO within the adsorber. Reference Appendix 1 for complete incident timeline.
2. Due to the low mercury emission limit required for new fluidized bed incinerator (40CFR60 subpart LLLL), a highly efficient mercury control technology is needed. CPPE's GAC bed adsorber was chosen for mercury control.
3. In North America, CPPE has total of 16 GAC adsorbers for municipal sludge incineration at 9 different facilities. Out of those 16 adsorbers, 4 adsorbers have experienced thermal excursion events that resulted in equipment damage, with one adsorber experienced thermal excursion events twice. All of the thermal excursion events occurred between the period of August 2016 and March of 2017, with the exception of this latest incident at NEW Water. A separate report provides comparison of NEW Water adsorber with other North American CPPE adsorbers.
4. In September 2016, during construction phase of the NEW Water's incineration system, NEW Water was informed of the first two thermal excursion incidents that occurred in August 2016. As such, NEW Water carried out an extensive HAZOP analysis with CPPE, Suez, the incinerator system integrator, and Jacobs, the design engineer, to determine proper operational and safety procedures.

5. CPPE has GAC adsorbers at 11 municipal or industrial waste incineration facilities in Europe, many with over 15 years of operational history. None have experienced a thermal excursion event to the knowledge of CPPE.
6. Based on the HAZOP study, a CO monitoring and water quench interlock system that would limit potential damage caused by thermal excursion events was proposed. However, that system was implemented in a way that did not adequately protect the system during this thermal excursion event.
7. CPPE GAC adsorber uses sulfur impregnated carbon made from anthracite coal. Typical CPPE adsorber bed has 3 layers. In US installation, all 3 layers are filled with carbon. In European installations, the first layer is a dust prevention layer with carbon media in layer 2 and 3.
8. Original design of CPPE's carbon media was a mix of carbon and lava rock. CPPE switched the carbon media in 2013 to all carbon to increase mercury removal efficiency.
9. An alternate GAC adsorber supplier has adsorbers in 5 municipality sludge incineration facilities in US with no known thermal excursion. But those facilities have less than 4 years of operational history.
10. All known CPPE carbon bed thermal excursion events occurred during shut-down or starting-up from a shut-down. No known carbon bed thermal excursion occurred during normal operational period. Literature research also indicates shut-down or starting from a shut-down is the most prevalent period for carbon bed thermal excursion.

POSSIBLE MECHANISM FOR ADSORBER THERMAL EXCURSIONS

Based on study of CPPE's past incidents, discussion with CPPE, discussion with industrial experts, and literature research on hot spot and thermal excursion in similar GAC adsorber bed, it is believed that hot spots develop on carbon when organic compounds or moisture are adsorbed onto the carbon. As the adsorption process is exothermic, it will release heat at the adsorption site. If the rate of heat removal is not as high as rate of heat generation, the heat could build up to the point that carbon, sulfur and/or other organics previously adsorbed in the carbon starts to oxidize, which generate more heat and carbon monoxide, starting a thermal excursion event.

POSSIBLE FACTORS CONTRIBUTING TO CARBON BED THERMAL EXCURSIONS

Given the possible mechanism that could cause hot spots that lead to carbon oxidation, following is a list of possible factors that could contribute to carbon bed thermal excursion.

1. **Flue Gas Cleaning**
   Adsorption of organic compounds and moisture onto carbon is the most likely source of heat that creates hot spots. Per CPPE, there has been no known case of thermal excursion in their European installations. One noted difference between European installations and US installations are CPPE's adsorbers in Europe typically have a dust protection layer, which is filled with inert material, before two layers of carbon media. CPPE's US installations typically have 3 layers of carbon media, with no inert dust protection layer. While the flue gas in all installations has been cleaned by top of the line air pollution control technology, it is possible the dust protection layer provided some additional removal of moisture and organic compounds that minimizes the hot spot formation. The inert layer may also have higher preferential to absorb water vapor, which lessens the amount of water available to be adsorbed by carbon and generate heat for potential hot spot. The alternate carbon adsorber vendor also uses additional filter equipment upstream of the carbon bed to remove fine particles and moisture from the gas stream.

2. **Type of Carbon**
   CPPE uses carbon produced from anthracite coal, while the alternate vendor uses carbon produced from bituminous coal. Typically carbon manufactured from anthracite coal has smaller pore structures, with a higher amount of surface area. While the additional surface area could provide better adsorption efficiency, it also provides more adsorption area for heat of sorption generation. Carbon specified by CPPE is being analyzed along with two other types of carbon to positively determine the pore structure and other differences such as auto-ignition temperature, pellet size, etc. that might affect the carbon's tendency to ignite.

3. **Operational factor**
   All known CPPE adsorber thermal excursion incidents occurred while the adsorbers were either offline or in their transitional period from offline to normal operation. It is possible that during normal operation the constant gas movement keeps the carbon bed cool enough to prevent formation of hot spots that could lead to oxidation or combustion; however, during the offline period with no gas flow through the carbon bed, if a hot spot developed, the heat has limited ways to dissipate and could lead to oxidation when air is introduced.

   Non-uniform drying after washing of the carbon bed could also lead to potential hot spots. Prior to this thermal excursion incident, the bed was washed then dried by heated air. However, the

whole carbon bed cannot be dried evenly and thoroughly without over-drying the front layer(s). The drying procedure ended when the front part of bed was dried to less than 2% moisture but the back part of the bed was still at over 35% moisture. The natural dryness of the bulk carbon in typical ambient condition is about 6-7% moisture and CPPE does not recommend drying to much below this level. This provides opportunities for water to be released from wetter part of the bed to be adsorbed and generate heat by the drier part of the bed. With the drier part of the bed has greater ability to adsorb water to release heat of adsorption and is already at higher temperature, it increases the likelihood of hot spot formation.

4. **Carbon bed temperature**
   During offline mode, bed temperature affects the release of CO from carbon, with more CO released when bed is at a higher temperature. This release of CO is believed to be caused by oxidation of carbon and other organic compound on the carbon, which is highly exothermic process. This, combined with lack of air flow to remove the heat, increases the likelihood of hot spot formation leading to thermal excursion. Therefore, prior to isolating the carbon adsorber and placing it into offline mode, the carbon bed should be reduced to near ambient temperature.

5. **Failure of protective interlocks**
   The protective system was designed by CPPE to automatically quench the bed with water when either high adsorber CO or high carbon bed temperature level has been detected. However, the protective system Suez implemented did not function as CPPE originally intended. Suez implemented the system in a way that prevented quenching on high CO alone, and this change was not properly communicated to NEW Water. Suez's protective interlock implementation requires both high CO and high carbon bed temperature to activate the quench, to avoid possible nuisance quenching of the carbon bed. The reliance of the protective system to detect high carbon bed temperature prior to quenching is also potentially problematic because the location of the existing carbon bed temperature probes are separated from much of the carbon bed by internal fiberglass walls. The extent of the internal damage caused by the thermal excursion event was exacerbated by how the protective system was implemented combined with the reduced ability to detect the temperature rise in the carbon bed with the existing temperature probes.

6. **Formation of acid salt crystal**
   It was noted that acid salt crystals were formed on the carbon bed. This crystal formation has been noted in several other carbon adsorbers and is not an indication of improper equipment operation. However, this deposit has two negative impacts towards the operation of the adsorber bed.

First, the deposit could prevent gas to freely flowing through the carbon bed and increase the gas flow pressure drop across the bed. This requires more frequent wash-down of the carbon bed. The drying period after a wash-down and subsequent start-up has higher possibility of thermal excursion event compared to normal operational period.

Secondly, the deposit seems to "clump" the carbon. This prevents the free flow of the carbon, causing operational issues such as preventing reinsertion of the sampling probe and more difficulty in removing the carbon. More importantly, this clumping might isolate certain area of the carbon bed, preventing proper flow of gas through the area or water during a wash-down or quench. This could lead to hot spot formation due to lack of gas flow to carry away the heat or prevent the hot spot be properly extinguished through quenching.

7. **Sulfuric organic compounds**

   Certain sulfuric organic compounds are known to produce large amount of heat of adsorption. It might be possible the sulfur in the flue gas stream or sulfur impregnated on carbon has certain reaction pathways that form these organic sulfuric compounds creating a large amount of heat as they are adsorbed onto the carbon. The mercury adsorbed on the carbon could also act as catalyst for certain organic sulfur reactions. However, investigation of these potential reaction pathways is beyond the scope of this report and it is difficult to quantify the effect of this factor without further study.

CONCLUSION

Based upon CBE's review of this thermal excursion event and comparison study of history with other facilities' carbon adsorber bed operation, including the known factors and possible factors that would contribute to hot spot formation, we believe the following is the most likely cause for the Nov. 7, 2019 event. First, the carbon bed had some formation of crystal deposits, most likely acid salt, which caused air flow restriction. The increased pressure drop promoted the washing of the bed during the incineration system's maintenance shut-down. After washing, the bed was dried, but could not be dried evenly to around 10% moisture throughout the bed per CPPE's procedure. Instead, the bed was over-dried to less than 2% moisture in the first two layers of carbon, but still over 35% moisture in the last layer of carbon. The adsorber was isolated in this condition, provided opportunity for free moisture and possibly other organics to be adsorbed by the overly dried carbon in the first two layers. The heat of adsorption created a hot spot within the carbon bed, which could not dissipate due to lack of gas flow in the isolated adsorber. The hot spot was able to reach a temperature that could oxidize the carbon or sulfur on the carbon, so once oxygen is introduced by the start-up blower, carbon then starts to rapidly oxidize and a high temperature excursion was initiated.

However, due to the complex chemistry of activated carbon interaction, relatively small sample size of facilities available to study, limited process information on the adsorber, and inability to analyze the carbon within the carbon bed during the thermal excursion event knowing their exact location in the bed, the exact mechanism of the hot spot formation which lead to the thermal excursion cannot be precisely determined. As such, a list of mitigation actions, both to potentially preventing the thermal excursion and reduce potential damaging effect of the thermal excursion are proposed below.

POTENTIAL MITIGATION ACTIONS

Based on above possible contributing factor that contributes to thermal excursion, a list of possible potential actions that can be taken to minimize the effect of those factors is provided below. Please note that this is not intended to be a list of all actions that need to be taken. It is provided as a comprehensive list of possible actions that might affect the probability and magnitude of a thermal excursion event for NEW Water to discuss and consider. The next section will attempt to quantify the relative effectiveness of each action listed to aid NEW Water's consideration.

1. **Additional gas cleaning**
   As carbon bed hot spots are likely caused by adsorption of organic or water vapor, additional gas cleaning could reduce the chance of hot spot formation. Reducing amount of acid gas passing through the carbon bed will also minimize the formation of acid salt crystals, which would lead to high pressure drop through the bed and prevent well distributed gas flow through the bed that's needed to carry away any heat generation.
   Potential Actions
   a. Optimize the performance of existing upstream air pollution control equipment. As acid in the flue gas will form crystal on the carbon that would increase pressure drop and possibly restricting free air flow through the bed, the acid removal from the flue gas need to be maximized. Minimizing amount of acid gas through the carbon bed also minimize potential heat of adsorption.
   b. Investigate the benefit and impact of changing the first carbon bed layer to a dust protection layer: CPPE's European installations have a dust protection layer in the first GAC bed layer and no known installations with this arrangement have experienced a thermal excursion event. This dust protection layer could also potentially absorb moisture, limiting amount of moisture available to be adsorbed by carbon and generate heat. However, the GAC adsorber system, with only two carbon layers, may not be able to provide the mercury removal efficiency necessary to meet the emission limits based on the initial design requirements.
   c. Investigate the need for any additional upstream gas cleaning equipment, such as a HEPA filter to remove additional particulate from the gas stream. However, implementing this option will take time to evaluate equipment design and equipment

procurement and should only be considered if a review of particulate levels entering the GAC are excessive.

2. **Different carbon media**

   As discussed previously, carbon with a higher surface area or lower auto-ignition temperature is at higher risk of thermal excursion. A different type of carbon media could reduce the potential of thermal excursion. CPPE's original adsorber design used a mix of carbon and lava rock in the bed media. There is no known major thermal excursion incident in adsorber utilizing a mixed media bed material, including one US installation that has been using the mix media for 17 years.

   Potential Action:

   a. Evaluate switching the bed carbon media to one with lower surface area and higher auto ignition temperature. However, CPPE likely cannot guarantee performance with adsorber bed that utilizes carbon different from the originally specified. The alternate carbon adsorber vendor using a bituminous based carbon has met the emission limit for new fluidized bed incinerator in other waste water treatment facilities.
   b. Evaluate using a mixture of carbon and lava rock as bed media. This is the original bed material for CPPE units and the rock was designed to carry away heat to limit hot spot formation and reduce possibility of thermal excursion. However, this will likely have negative impact on performance. In some facilities, the rocks also react with acid in the flue gas and create operational issue and more frequent changing of the carbon media. CPPE does not recommend this approach.

3. **Continue system operation**

   As all known thermal excursion events occurred either when the adsorber units were offline or in transition from offline to online, it indicates that during normal operation, there is enough gas flow through the adsorber to minimize the formation of hot spots. Therefore, operationally, it would be best to have continuous gas flow though the carbon bed preventing heat buildup that could lead to hot spot formation. Having gas flow also makes CO monitoring easier as it allows comparing adsorber's inlet and outlet CO values to determine degree of CO generating within the carbon bed.

   Potential Actions:

   a. Evaluate the ability to maintain air flow continuously through the adsorber to keep the unit cool. For short term shutdowns, keep the system in stand-by mode with a continuous air flow through the system. However, this may also have the potential of fanning a small yet undetected hot spot. A robust CO monitoring system is needed to detect carbon oxidation at early stage.

4. **Dry out procedure**

Adsorption of moisture in the GAC is an exothermic reaction and CPPE believes it is the primary factor leads to carbon bed hot spot formation. During the November thermal excursion incident, the bed was partially dried with the first two layers moisture <2% and the third layer moisture at >35% before shutting down and isolated for six days. It is possible when the adsorber is offline, moisture from the relatively wet carbon evaporated then condensed/adsorbed onto the dry carbon in the front layers, generating heat and creating a hot spot.

Potential Actions:

a. Evaluate drying procedure modifications that instead of going to shut down mode after drying, switch to stand-by mode with continue operation of the start-up fan to maintain air flow through the carbon bed. This procedural change needs to be fully discussed with CPPE.
b. Evaluate drying procedure modification of switching directly to online mode to keep air flow through the adsorber to remove heat. With the last layer of carbon still relatively wet, the system's performance will not be optimum. This procedural change needs to be fully discussed with CPPE.
c. Evaluate the possibility of adding a gas recirculation loop for drying. By recirculating part of the relatively moist gas for drying, this will allow for a more even drying throughout the different layers of the bed, instead of having first layer to be over dried and last layer to be under dried. The would require extensive modification and ducting to the adsorber system.
d. Consideration of disposing the carbon after a quench in lieu of attempting to dry the carbon. This would have significant cost implications.

5. **Restart procedure after shut down**

When the adsorber is offline, heat from any hot spot formation cannot be carried away by gas flow. Given the history of previous CPPE adsorber thermal excursion incidents, the offline period and restarting after an offline period are the critical times where thermal excursion event is most likely to occur.

Potential Action:

a. Evaluate training of the operators so they are more aware of the various signs of hot spot formation and when corrective actions need to be taken. The CO level prior and during a restart should be closely monitored. If CO level is high, additional carbon bed temperature monitoring should be utilized to further inform if a hot spot is actually occurring. If needed, use protective system's water quench to extinguish any hot spots in the bed.
b. Evaluate the possibility of adding a nitrogen purge system to purge the bed either during restart or when hot spot formation has been noted. This would have significant cost impact.

6. **More robust monitoring and protective system**

   Based on NEW Water, the current CO monitoring system is offline approximately 25% of the time. High CO, especially higher CO at outlet vs. inlet is the best indication of a hot spot developing in the carbon bed. A highly reliable CO monitoring system is important in early detection of hot spot formation.

   Potential Action:

   a. Review the CO monitoring system maintenance program for improvement: Per NEW Water, one reason for the high down time rate of the CO monitoring system is due to lack of readily available spare parts when the system needed to be serviced. A better spare parts inventory will help reduce the down time of CO monitoring system.
   b. Evaluate a change of the adsorber CO monitoring system: Current CO monitoring system's down time rate of 25% is too high for such a critical protection device. If changes to the system maintenance and spare parts program are not effective, a change to a system with higher reliability may provide better protection. CBE has provided information to NEW Water CO monitoring system used by other facilities.
   c. Consideration for adding additional gas sampling locations. CBE provided a manual gas sampling design that could be incorporated allowing for multi-point manual CO sampling during critical phase of system operation, such as start-up after shutdown, or when main CO monitoring system detects abnormal CO readings. Each of the sampling points can also be equipped with temperature monitoring device to provide a more complete view of the adsorber's temperature profile.
   d. Consideration for additional carbon bed temperature monitoring: Current arrangement of only two carbon bed temperature probes (on upper and lower section of 3rd layer) does not adequately monitor for hot spot formation, especially considering the presence of the two internal fiberglass walls that separate these probes from other area of the carbon bed. Additional bed temperature probes should be considered. With the additional temperature probes, the temperature change in the adsorber can be viewed more clearly and this provides an additional benefit of providing a way to view the flow distribution.

7. **Proper Protective System Interlocks**

   Due to experience of previous thermal excursion events at other facilities, an automatic quenching system was put in place to automatically quench the bed with water when CO level or carbon bed temperatures reached a high level. However, the system that was implemented was different from what CPPE proposed. As such, that part of protection system was not adequately implemented and didn't function as expected.

   Potential Action:

   a. Perform functional check of all interlocks to ensure all protective functions will operate properly.

b. Consider modification to the protective system interlocks so they will still be functioning when adsorber is in any mode, including during shut-down mode.
c. Review system programming and interlocks with Suez to ensure all parties have same understanding of how the entire incinerator system should operate.

8. **Adsorber Design Change To Improve Air Flow**
Some adsorber design changes could improve air flow through the carbon bed to limit creation of hot spots. As these require changes to the adsorber design, they need to be properly discussed with CPPE and have final design provided by CPPE.
Potential Action:
a. Inlet baffle design. The vessel has single band across the adsorber inlet to redirect the inlet gas across the carbon bed. However, it is CBE's opinion that this might not be adequate to evenly distribute gas flow, which as noted previously is important to provide proper cooling of the carbon bed. CPPE should consider modeling the inlet flow dynamic to determine whether the inlet baffle design can properly distribute the gas flow across the entire bed.
b. Air gap between carbon layers: Suez has advised some facilities to remove 2nd layer of carbon to provide an air gap between the layers. Suez believes this could allow better dissipation of heat. CBE does not agree with this opinion. However, CBE does believe an air gap between the carbon layers would allow the gas flow to be better distributed in the carbon layer after the air gap. CPPE could consider adding more internal baffle to provide air gap without sacrificing carbon volume too much.

MITIGATION ACTION PRIORITY

The section above compiled a comprehensive list of potential mitigation actions. However, not all of those actions are of equal importance and require same priority to be implemented. In order to quantify the importance of the various mitigation actions that could be taken, following equation is used:

AP = P * M – N

Where:

AP = Action Priority, a numerical summary on the importance of each action from 0 to 25, with 25 being of highest priority and 0 to be of lowest priority

P = Possibility Factor, how likely is this mitigation action could prevent or mitigate a potential thermal excursion event. It is rated on a scale of 1 to 5, with 1 being unlikely to have any effect to 5 being almost certain to have an effect.

M = Magnitude Factor, if this action can affect a thermal excursion event, what magnitude would the action contribute to the event. It is rated on a scale of 1 to 5 with 1 being having a small effect on the thermal excursion to 5 being able to completely prevent the event.

N = Negative Impact factor, how much would this action negatively impact the system with performance, time to implement, and other factors. It is rated from 0 to 10

Action	Possibility	Magnitude	Negative Factor	Priority
1a: Optimization of existing upstream air pollution control equipment	3	3	0	9
1b: Adding a dust protection layer	3	4	7, Adsorber performance reduced due to only 2 layers of carbon.	5
1c: Additional upstream filters	2	4	5, long lead time to implement. Require system design review and possible ID Fan upgrade.	3
2a: Use an alternative carbon media	3	4	3, CPPE cannot guarantee performance.	9
2b: Adding lava rock to carbon media	4	4	7, Adsorber performance reduced. CPPE cannot guarantee the mercury emission limit will be met.	9
3a: Continue system operation	4	3	2, an untried procedural sequence.	10
4a: Do not go to shutdown mode after drying. Go to stand-by mode and keep the air flow through the bed.	4	3	4, Untried procedural sequence. The fresh air might fan any hot spot.	8
4b: Go to operational mode before the 3rd bed is completely dry	3	4	4, Require procedure change from CPPE. If the 3rd layer is still relatively wet, the adsorber's performance would be impacted until the bed is dried.	8
4c: Adding a gas recirculation loop to the carbon adsorber.	2	3	5, Requires additional fan, valves, and ducting for the recirculation loop.	1
4d: Dispose of carbon in lieu of drying.	3	3	5, High cost of replacing carbon after each quench event. Require storage area for a full load of carbon due to long lead time of obtaining carbon.	4

Action	Possibility	Magnitude	Negative Factor	Priority
5a: Additional training for operator to recognize hot spot formation and proper action to take.	3	4	2, require additional training for operators.	10
5b: Nitrogen purging prior to start-up.	4	3	6, high cost to implement a nitrogen purge program.	6
6a: Better CO system maintenance program.	5	3	1, Need to review the CO system's maintenance program to ensure proper amount of spare parts is available. Contact CO system vendor to ensure proper support is available when needed.	14
6b: Using a different CO monitoring system.	4	3	4, Additional cost and time to change the CO system.	8
6c: Multipoint CO sampling system	3	4	3, Additional cost and time to implement the system. Given manual sampling is needed, the task of getting manual sample from 27 points might be overwhelming to the operator.	9
6d: Additional bed temperature monitoring	3	3	2, Additional equipment modification and programing required.	7
7a: Check CO quench interlock function to ensure it is properly implemented	4	4	3, could create unnecessary nuisance quench resulting in system down time and costly replacement of carbon	13
7b: CO interlock to quench the carbon bed remains active when adsorber is offline.	5	4	5, could create unnecessary nuisance quenching resulting in system down time and costly replacement of carbon.	15
7c: Review system programing and interlock with Suez	3	4	1, requires time to review programing with Suez	11
8a: Redesign inlet baffle	3	3	5, require adsorber redesign by CPPE	4
8b: Leave 2nd layer of bed empty	3	3	3, might not meet the emission limit with only 2 layers of carbon	6

APPENDIX I: EVENT TIME LINE

March 2018: Incinerator system started-up

May 2018: Incinerator system fully commissioned. Incinerator system typically ran 3 ½ days on, 1 ½ days off. During off days, the GAC system went into shut down mode. No abnormal CO spiking observed during these shut-down periods.

August 2019: Adsorber DP increased slowly during 14 months of operation (From 3.7" to 4.7"). Incinerator system shut down for 2 weeks due to repair work needed for the waste oil heat exchanger. No historical CO reading available during this shut down period.

August 22, 2019: repair completed and incinerator system placed back online.

Oct 1 to Oct 10, 2019 - Adsorber DP climbed rapidly (From 5.9" to 8.8"). However, no process reason can be determined by NEW Water for the accelerated DP increase. The incinerator was running nearly full time during this period in anticipation of the maintenance shutdown.

Oct 8, 2019 to Oct, 16 2019 – CPPE was contacted by NEW Water regarding to the rapid increase of the Adsorber DP. CPPE reviewed operational data and trends and concluded the likely cause was accumulation of PM/dust or salt on first layer of the bed. CPPE recommended to NEW Water to check operation of upstream APC equipment for possible carryover of PM, salt and/or SO2.

Oct 19 2019 - Incinerator system shutdown for annual preventive maintenance. Adsorber DP at 10.6", near the 11" trip point. White crystals were observed in the carbon bed. The crystals were not analyzed for composition, but were sampled and dissolved in deionized water. The resulting solution was acidic. CPPE suspects the crystals to be sulfuric acid salts formed by SO2/SO3 presented in the gas. CPPE recommended rinse down of the bed to recover bed pressure loss. After the sampling probe was removed from the bed, it couldn't be inserted back in, even with a ½" threaded rod, indicating the carbon was bonded together. Condensate at bottom of the vessel is highly acidic.

Oct 24, 2019 06:50 - Commenced wash down per CPPE procedure.

Oct 24 to 29, 2019 - Washing of carbon bed. Wash water was plant water. As this is outside of plant disinfection season, there are no added chlorine in the water. Wash drain water had pH of 0.3 initially. Drain water pH reached 2.0 after 24 hours of washing. pH reached 4.7 on Oct. 28th then 6.1 on Oct. 29th.

Oct 29 to Nov 1, 2019: Carbon bed drying using start-up heater and start-up fan. Start-up heater outlet set at 115°F.

Nov 1, 2019: First 2 beds had moisture content of less than 2% based on sample testing. 3rd bed had moisture content of around 35%. The drying process was stopped when upper bed temperature rose to

69°F with lower bed temperature showing 66°F. Carbon bed drying stopped at 2am and GAC system is placed into shutdown mode with adsorber inlet and outlet isolation valves closed.

Nov 1 to 7, 2019: Carbon adsorber isolated as PM team working on other incinerator issues. Incinerator was empty of sand and was not placed into operation during this time. CO reading rose during this period from 80 ppm on 00:30 of Nov 1st to over 500 ppm on 23:00 of Nov 2nd, with accelerated rate from 19:00, Nov 2nd. Note, the automatic quench should have triggered when CO reached over 200 ppm on Nov 2nd.

Nov 6, 2019 12:30: A purge of 3 min was attempted for approximately 3 min. CO dropped from over 500 ppm to 100 ppm before rising back to over 500 ppm in 8 hours.

Nov 7, 2019: Start to warm up the incinerator. Sand addition on evening of 7th.

Nov 7, 2019: Attempted to start-up the carbon bed. Due to concern of fire, air was bumped into adsorber by turning the fan on for 15 sec then wait 2 to 3 min. The fan was bumped about 6 times. CO level initially dropped (possibly due to faulty reading from CO analyzer which was been worked on at the same time) but then CO reading started to rise again. When the abnormal readings were noted, NEW Water communicated closely with CPPE to determine proper corrective action procedure. After confirmation of high CO by stack CEMS and hand held CO meter, in addition to concern over carbon bed temperature manual quench procedure was initiated with consent from CPPE. After quenching started, CO and temperature rose for several more minutes before lowering to normal level.

Attachment C
to 2/27/2020 report

NEW Water
The brand of the Green Bay Metropolitan Sewerage District

Emissions of Mercury during GAC Malfunction
Green Bay Metropolitan Sewerage District (NEW Water)
November 21, 2019 – February 13, 2020

The purpose of this report is to provide a summary of emissions of mercury while incinerating sewage sludge without use of the granulated activated carbon (GAC) adsorber on a limited basis from November 21, 2019 until February 13, 2020. The GAC was rendered inoperable after a high temperature condition caused extensive internal damage to the unit.

GBMSD is subject to two emission limits for mercury under its air operation permit. The first is a mass limit of 3.2 kg (7.1 pounds) per 24-hour period, established under the National Emission Standard for Mercury (40 CFR 61, Subpart E). The second is a concentration limit of 0.0010 milligrams per dry standard cubic meter (mg/dscm), corrected to 7% oxygen, established under the Standards of Performance for New Stationary Sources: Sewage Sludge Incineration Units (40 CFR 60, Subpart LLLL).

Mercury Emissions – Mass

GBMSD demonstrates compliance with the mass limit for mercury of 3.2 kg (7.1 pounds) per 24-hour period in two ways; by conducting emissions testing and by calculating emissions using sludge feed and mercury content of sludge.

Emissions testing

Emissions testing for mercury while incinerating sewage sludge without the GAC was conducted on December 12, 2019. GBMSD's other air pollution control processes, including combustion temperature control, wet scrubber, and wet electrostatic precipitator, were operating at all times when incineration took place, including during emissions testing. EPA Method 29 was used to measure emissions of mercury. Results showed that mass emissions of mercury without the GAC were 0.0155 pounds per 24-hour period, which is in compliance with the 7.1 pounds per 24-hour limit.

Emissions calculation

To estimate emissions on a mass basis while incinerating sewage sludge without use of the GAC, Wisconsin Department of Natural Resources (WDNR) requested that GBMSD analyze a weekly sewage sludge sample for mercury content and use that value, along with the sludge charging rate to the incinerator, as inputs for the equation in Operating Permit 405004600-P30, Section F.5 (b)(2)(d).

$$E_{Hg} = \frac{MQF_{sm(avg)}}{1000}$$

where:
E_{Hg}=Mercury emissions, g/day.
M=Mercury concentration of sludge on a dry solids basis, µg/g.
Q=Sludge charging rate, kg/day.
F_{sm}=Weight fraction of solids in the collected sludge after mixing.
1000=Conversion factor, kg µg/g^2.

Beginning on December 12, 2019 a grab sample of sewage sludge was taken each week until the GAC was returned to service on February 13, 2020. The mercury content of each weekly sample was applied when calculating mercury emissions from all incineration that took place Sunday through Saturday of the week during which the sample was taken. For the weeks before weekly sampling commenced, the highest mercury result that occurred during the GAC outage was applied (0.62 ug/g on January 15, 2020).

Results are summarized in Table 1. Using the equation above, daily emissions of mercury ranged from 0.004 pounds per day to 0.054 pounds per day, with an average of 0.028 pounds per day. The applied equation assumes that no removal of mercury occurred; however, please note that even without the GAC, GBMSD's emissions of mercury were controlled by a wet scrubber, a wet electrostatic precipitator, and maintenance of allowable combustion temperature whenever incineration of sewage sludge occurred. GBMSD demonstrates compliance with its permitted limit for mercury mass emissions.

Table 1 GBMSD mercury mass emissions - November 21, 2019 through February 12, 2020

Date	*M* Mercury Concentration of Sludge (ug/g)[1,2]	*Q* Sludge Charging Rate (wet kg/day)	F_{sm} Weight Fraction of Solids	*Conversion Factor* ($kg\ ug/g^2$)	E_{hg} Mercury emissions (g/day)[3]	Mercury Emissions (lb/day)	Mercury Emissions Limit (lb/day)
11/21/2019	0.62	38,031	0.375	1000	8.8	**0.019**	7.1
11/22/2019	0.62	87,492	0.404	1000	22	**0.048**	7.1
11/23/2019				OFFLINE			
11/24/2019	0.62	68,764	0.356	1000	15	**0.033**	7.1
11/25/2019	0.62	105,340	0.354	1000	23	**0.051**	7.1
11/26/2019	0.62	93,487	0.42	1000	24	**0.054**	7.1
11/27/2019	0.62	55,281	0.376	1000	13	**0.028**	7.1
11/28/2019				OFFLINE			
11/29/2019	0.62	85,155	0.409	1000	22	**0.048**	7.1
11/30/2019	0.62	97,731	0.407	1000	25	**0.054**	7.1
12/01/2019	0.62	95,865	0.412	1000	24	**0.054**	7.1
12/02/2019	0.62	85,028	0.383	1000	20	**0.045**	7.1
12/03/2019				OFFLINE			
12/04/2019	0.62	40,629	0.35	1000	8.8	**0.019**	7.1
12/05/2019	0.62	43,047	0.387	1000	10	**0.023**	7.1
12/06/2019	0.62	39,509	0.411	1000	10	**0.022**	7.1
12/07/2019	0.62	100,316	0.373	1000	23	**0.051**	7.1
12/08/2019				OFFLINE			
12/09/2019				OFFLINE			
12/10/2019				OFFLINE			
12/11/2019	0.24	21,122	0.389	1000	2.0	**0.004**	7.1

Date	*M* Mercury Concentration of Sludge (ug/g)[1,2]	*Q* Sludge Charging Rate (wet kg/day)	F_{sm} Weight Fraction of Solids	*Conversion Factor* ($kg\ ug/g^2$)	E_{hg} Mercury emissions (g/day)[3]	Mercury Emissions (lb/day)	Mercury Emissions Limit (lb/day)
12/12/2019	0.24	102,988	0.389	1000	9.6	**0.021**	7.1
12/13/2019	0.24	102,107	0.359	1000	8.8	**0.019**	7.1
12/14/2019				OFFLINE			
12/15/2019				OFFLINE			
12/16/2019				OFFLINE			
12/17/2019				OFFLINE			
12/18/2019				OFFLINE			
12/19/2019				OFFLINE			
12/20/2019	0.53	76,426	0.363	1000	15	**0.032**	7.1
12/21/2019	0.53	97,920	0.372	1000	19	**0.043**	7.1
12/22/2019				OFFLINE			
12/23/2019				OFFLINE			
12/24/2019				OFFLINE			
12/25/2019				OFFLINE			
12/26/2019	0.29	88,732	0.371	1000	9.6	**0.021**	7.1
12/27/2019	0.29	91,346	0.391	1000	10	**0.023**	7.1
12/28/2019	0.29	86,031	0.403	1000	10	**0.022**	7.1
12/29/2019				OFFLINE			
12/30/2019				OFFLINE			
12/31/2019				OFFLINE			
01/01/2020	0.38	91,327	0.384	1000	13	**0.029**	7.1
01/02/2020	0.38	40,160	0.398	1000	6.1	**0.013**	7.1
01/03/2020	0.38	24,257	0.381	1000	3.5	**0.008**	7.1
01/04/2020	0.38	102,711	0.381	1000	15	**0.033**	7.1
01/05/2020	0.23	105,290	0.334	1000	8.1	**0.018**	7.1
01/06/2020	0.23	47,576	0.385	1000	4.2	**0.009**	7.1
01/07/2020				OFFLINE			
01/08/2020				OFFLINE			
01/09/2020				OFFLINE			
01/10/2020	0.23	55,113	0.394	1000	5.0	**0.011**	7.1
01/11/2020	0.23	95,397	0.38	1000	8.3	**0.018**	7.1
01/12/2020	0.62	34,381	0.416	1000	8.9	**0.020**	7.1
01/13/2020				OFFLINE			
01/14/2020				OFFLINE			
01/15/2020				OFFLINE			
01/16/2020				OFFLINE			

Date	*M* Mercury Concentration of Sludge (ug/g)[1,2]	*Q* Sludge Charging Rate (wet kg/day)	F_{sm} Weight Fraction of Solids	*Conversion Factor* ($kg\ ug/g^2$)	E_{hg} Mercury emissions (g/day)[3]	Mercury Emissions (lb/day)	Mercury Emissions Limit (lb/day)
01/17/2020	0.62	77,234	0.383	1000	18	**0.040**	7.1
01/18/2020	0.62	96,186	0.366	1000	22	**0.048**	7.1
01/19/2020				OFFLINE			
01/20/2020				OFFLINE			
01/21/2020				OFFLINE			
01/22/2020				OFFLINE			
01/23/2020				OFFLINE			
01/24/2020	0.21	40,333	0.396	1000	3.4	**0.007**	7.1
01/25/2020	0.21	80,789	0.4	1000	6.8	**0.015**	7.1
01/26/2020				OFFLINE			
01/27/2020				OFFLINE			
01/28/2020				OFFLINE			
01/29/2020				OFFLINE			
01/30/2020				OFFLINE			
01/31/2020	0.50	50,566	0.351	1000	8.9	**0.020**	7.1
02/01/2020	0.50	102,969	0.364	1000	19	**0.041**	7.1
02/02/2020				OFFLINE			
02/03/2020				OFFLINE			
02/04/2020				OFFLINE			
02/05/2020				OFFLINE			
02/06/2020				OFFLINE			
02/07/2020	0.21	78,882	0.4	1000	6.6	**0.015**	7.1
02/08/2020	0.21	86,331	0.383	1000	6.9	**0.015**	7.1
02/09/2020	0.18	30,887	0.388	1000	2.2	**0.005**	7.1
02/10/2020				OFFLINE			
02/11/2020				OFFLINE			
02/12/2020				OFFLINE			

Notes:

(1) Mercury content as measured during weekly grab samples of sewage sludge. Sludge result was applied during all incineration that took place during the week the sample was grabbed, Sunday through Saturday.

(2) Weekly sludge samples began the week of December 12, 2019. For incineration that occurred prior to that, the highest mercury result was applied (0.62 ug/g)

(3) Equation from Permit Section F.5(b)(2)(d)

Mercury Emissions – Concentration

Emissions testing was performed on December 12, 2019 to measure emissions of mercury while the incinerator combusted sewage sludge without use of the GAC. Results showed that emissions of mercury during emissions testing were 0.0220 mg/dscm, corrected to 7% oxygen, which exceeds the permit limit of 0.0010 mg/dscm, corrected to 7% oxygen. The test report was submitted to US EPA and WDNR on January 24, 2020. Results from emissions testing were summarized and discussed in a cover letter and supplemental memo that accompanied the emissions test report. (The cover letter and supplemental memo can be found in Appendix 1 to this letter.)

APPENDIX 1

SUPPLEMENTAL SUMMARY AND DISCUSSION OF MERCURY EMISSIONS TESTING RESULTS TEST DATE DECEMBER 12, 2019

NEW Water
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January 23, 2020

Ms. Tania Taff
Air Management Engineer – Division of Environmental Management
Wisconsin Department of Natural Resources
2984 Shawano Ave
Green Bay, WI 54313-6727

RE: Testing for emissions of mercury from I08 without use of granulated activated carbon

Dear Ms. Taff:

The purpose of this letter is to submit and discuss results for emissions testing that Green Bay Metropolitan Sewerage District (GBMSD) has opted to conduct on Process I08, the fluid bed incinerator.

Background

In 2018, GBMSD began operation of a new fluid bed incinerator (FBI) that is subject to 40 CFR 60, Subpart LLLL, Standards of Performance for New Sewage Sludge Incineration Units, which include limits for mercury emissions. GBMSD installed a granulated activated carbon (GAC) unit to control mercury emissions, if needed, to meet the new limits. Compliance emissions testing in October 2018 and May 2019 demonstrated that mercury emissions have been within the limits while operating the GAC.

A malfunction that occurred on November 7, 2019, described in a written report to the United States Environmental Protection Agency (US EPA) dated December 31, 2019, left the GAC inoperable. GBMSD implemented numerous alternative options for managing sludge, but after several weeks, determined that the ability to treat wastewater effectively would be compromised without incinerating some sewage sludge. As such, limited incineration of sewage sludge without the GAC began on November 21, 2019.

To measure the mercury emission rate and evaluate the potential impacts of operating without the GAC, GBMSD conduct an emission test on December 12, 2019. All other emission control systems, (the combustion chamber temperature, a wet electrostatic precipitator, and scrubber) operate in accordance with their respective allowable operating parameters whenever the FBI is operated, including during the emission test. The enclosed report contains the results from that testing, which was conducted by Advanced Industrial Resources, Inc. Results show that the allowable mercury concentration exceeded the Subpart LLLL limit for new fluid bed incinerators while incinerating sewage sludge without operating the GAC.

While operating the FBI without the GAC might exceed the allowable mercury concentration, it does not pose a significant risk to the public. An air dispersion modeling evaluation was conducted by using the measured mercury emission rate without the GAC and comparing the results with health-based standards. The evaluation demonstrates that the impacts from the emission rate are well within state health-based standards. This evaluation is discussed in detail below.

Discussion

GBMSD conducted an emission test on December 12, 2019 to determine the mercury emission rate from the FBI without the GAC operating. The sludge feed rate during the test averaged 1.81 dry tons per hour, which is 85% of the 51 dry tons per 24-hour day capacity.

The measured mercury emission concentration from the December 12, 2019 test was 0.0220 milligrams per cubic meter (mg/m^3) corrected to 7% oxygen. While this emission concentration exceeds the Subpart LLLL emission limit, it meets several other standards, including the Subpart LLLL limit for new multiple hearth sewage sludge incinerators, as well as existing fluid bed and multiple hearth sewage sludge incinerators (see 40 CFR 60 Subpart MMMM). The measured mercury emission rate was 0.000646 pounds per hour (lb/hr), which meets the National Emission Standard for Mercury (see 40 CFR 61 Subpart E). This emission rate also meets Wisconsin's air toxics emissions standards for mercury (see Wis. Admin. Code§ NR 445, Table A). Table 1 compares the measured concentration and emission rate without the GAC in operation with each of these federal and state standards.

Table 1 Comparison of Mercury Emission Rate without GAC with Federal and State Standards

Regulation	Numeric Standard	Equivalent Hourly Standard	GBMSD FBI without GAC[1]	Meets Standard, Percent
Federal Standards				
Subpart LLLL New Fluid Bed Incinerator	0.0010 mg/m^3 @ 7% O_2		0.0220 mg/m^3 @ 7% O_2	Exceeds Standard
Subpart LLLL New Multiple Hearth Incinerator	0.15 mg/m^3 @ 7% O_2		0.0220 mg/m^3 @ 7% O_2	15 %
Subpart MMMM Existing Fluid Bed Incinerator	0.037 mg/m^3 @ 7% O_2		0.0220 mg/m^3 @ 7% O_2	59 %
Subpart MMMM Existing Multiple Hearth Incinerator	0.28 mg/m^3 @ 7% O_2		0.0220 mg/m^3 @ 7% O_2	8 %
40 CFR 61 Subpart E Sludge Incineration Plants	7.1 lb/24-hr	0.30 lb/hr	0.000646 lb/hr	0.2 %
Wisconsin State Standards				
NR 446.20(2) Sludge Incineration Plants	7.1 lb/24-hr	0.30 lb/hr	0.000646 lb/hr	0.2 %
NR 445 Table A Mercury, Inorganic Stack Ht > 75 ft	1,838 lb/yr	0.21 lb/hr	0.000646 lb/hr	0.3 %
NR 445 Table A Mercury, Inorganic Stack Ht > 75 ft	0.0405 lb/hr		0.000646 lb/hr	2 %

To estimate potential impacts on human health from operating the FBI without the GAC, GBMSD contracted with Short Elliot Hendrickson Inc. to conduct air dispersion modeling to calculate potential off-site mercury concentrations and to compare those potential impacts with state health-based standards. The ambient air quality standards for mercury are shown in the Wisconsin Administrative Code, NR 445, Table A.

These standards are a 24-hour average[2] concentration of 0.6 micrograms per cubic meter (µg/m^3) and an annual[3] average concentration of 0.3 µg/m^3. The air dispersion modeling was conducted in accordance with Wisconsin Air Dispersion Modeling Guidelines and the federal Guideline on Air Quality Models (40 CFR 51 Appendix W). A memorandum documenting the air dispersion modeling completed is enclosed.

For evaluation of the 24-hour standard, the actual days the FBI has run without the GAC and is anticipated to run without the GAC (November 21, 2019 through January 31, 2020) were modeled using the 0.000646 lb/hr mercury emission rate. The resulting highest impact, 0.00187 µg/m^3 is about 0.3 % of the 24-hour standard.

[1] The emission rate and emission concentration shown on this table are based on emission testing conducted at the GBMSD facility on December 12, 2019 without the operation of the GAC.
[2] Wisconsin's 24-hour standard is 2.4% of the mercury TLV the American Conference of Governmental Industrial Hygienists.
[3] Reference Concentration for Inhalation Exposure for mercury from EPA Integrated Risk Information System.

For the annual standard analysis, the FBI was modeled as "off" for the shutdown period (October 19, 2019 through November 20, 2019), "on" at 0.000646 lb/hr during the actual days when the FBI operated or is anticipated to operate without the GAC (intermittently from November 21, 2019 through January 31, 2020), and then "on" at the permitted mercury concentration rate for the remainder of the 365 day period (February 1 through October 18, 2020). The resulting impact, 0.00004 µg/m^3 is about 0.01% of the annual standard.

Table 2 – Modeling Results Compared with Ambient Air Standards for Mercury

Averaging Period	Modeled Concentration (µg/m^3)	Ambient Standard (µg/m^3)	% of Standard
24-hr	0.00187	0.6	0.3%
Annual	0.00004	0.3	0.01%

While operating the FBI without the GAC might exceed the allowable mercury concentration, modeling indicates that it does not pose a significant risk to the public. The air dispersion modeling evaluation demonstrates that the impacts from the emission rate are well within state health-based standards.

Please feel free to contact Julie Maas by phone at (920) 438-1045 or email at jmaas@newwater.us with any questions or comments you may have.

Sincerely,

GREEN BAY METROPOLITAN SEWERAGE DISTRICT

Thomas W. Sigmund, P.E.
Executive Director

c. Louise Gross, US EPA
Daniel Schaufelberger, US EPA
James Bonar-Bridges, WDNR
Thomas Henning, SEH

Enclosures:
1: Advanced Industrial Resources Sewage Sludge Incineration Unit Emission Test Report – Test Date December 12, 2019
2: SEH Technical Memorandum – Analysis of impact of Mercury Emissions from FBI

SEH

Building a Better World for All of Us®

TECHNICAL MEMORANDUM

TO: FILE

FROM: Jeremy Luebke

DATE: January 23, 2020

RE: Analysis of Impact of Mercury Emissions from FBI
SEH No. 153650 GODFR

The Green Bay Metropolitan Sewerage District (GBMSD) operates a fluid bed incinerator (FBI) and associated air pollution control equipment at their wastewater treatment plant located in Green Bay, Wisconsin. The purpose of this memorandum is to evaluate the potential impacts of operating the FBI without one of the emission control system, the Granular Activated Carbon (GAC) system. The GAC is designed to control mercury emissions.

The purpose of this memorandum is to document that the GBMSD demonstrates compliance with Wisconsin Administrative Code Chapter NR 445 Table A - *Emission Thresholds, Standards and Control Requirements for All Sources of Hazardous Air Contaminates,* specifically for mercury compounds, from the FBI (I08) when the GAC control device is offline.

NR 445.07 Emission thresholds, standards, control requirements and exemptions, paragraph (1)(a) states the following:

> *No owner or operator of a source may cause, allow or permit emissions of a hazardous air contaminant listed in Table A in such quantity or concentration or for such duration as to cause an ambient air concentration of the contaminant off the source property that exceeds the concentration in column (g) of Table A for the contaminant.*

Column (g) of Table A lists the Ambient Air Standard (per time period in column h expresses as micrograms per cubic meter).

NR 445.08 describes the acceptable methods by which to demonstrate compliance with the Ambient Air Standards in Table A. NR 445.08(1) requires that the determination of compliance shall be done while the source is operating under normal permit conditions, or in the absent of a permit, the maximum theoretical emissions. The incinerator mercury emission rate was determined in a December 12, 2019 stack test. The incinerator was operating under permit compliant conditions without the GAC operating, resulting in a worst-case scenario emission rate for mercury emissions. The emission rate for mercury, averaged over all three runs is 0.000646 lb/hr.

Compliance Demonstration via NR 445.08(2)(a) – Thresholds for Emission Rates

The first method that can be used to demonstrate compliance, as provided in NR 445.08(2), paragraph (a) is to show that emissions from the incinerator are below Table A Thresholds for Emission Points (expressed as pounds per hour or pounds per year) in columns (c), (d), (e), or (f), depending on stack height. The incinerator stack height has a height of 120 feet above grade, requiring emissions to be

compared to column (f) "Emissions from Stacks ≥75 ft" threshold values. If the source has emission rates less than the thresholds in Table A, column (f), it is assumed that the Ambient Air Standards in column (g) will not be exceeded.

NR 445.07 Table A, column (f) threshold values are not exceeded for inorganic mercury. In the following **Table 1 – Mercury Emission Rate Comparisons to Table A Thresholds for Emission Points**, Table A threshold values are compared to the stack test incinerator emission rate.

Table 1 – Mercury Emission Comparison

	December 2019 Stack Test (lb/hr)	December 2019 Stack Test (lb/yr)	Table A Thresholds for Stacks ≥75 ft (lb/hr)	*% of Table A Thresholds*
Hg	0.000646	-	0.0405	*1.60%*
	-	5.66	1,838	*0.31%*

Note: The annual emission rate is the hourly rate, 0.000646 lb/hr, multiplied by 8,760 hour per year.

Compliance Demonstration via NR 445.08(2)(b) – Ambient Air Concentrations

Secondly, NR 445.08(2) paragraph (b) provides the option to demonstrate that the ambient air concentration off the source property is less than the column (g) "Ambient Air Standards" for mercury are surpassed. This demonstration is conducted through dispersion modeling as shown below.

This dispersion modeling analysis was performed using the AMS/EPA Regulatory Model (AERMOD) (Version 18081) with the Lakes® AERMOD user interface. Five years (2011-2015) of preprocessed meteorological data, obtained from the WDNR website, were used in this analysis. The surface meteorological and upper air meteorological data were taken from the Green Bay, WI station.

The receptors used in this analysis consisted of a grid with fenceline receptors placed every 50 meters, 50-meter receptor resolution out to a distance of one kilometer, and receptors placed every 200 meters until a distance of two kilometers. Receptor points within the facility were not considered. As per WDNR policy, terrain elevations as derived from AERMAP were incorporated in the modeling analysis. Elevations were determined using USGS National Elevation Dataset (NED) files obtained from the USGS National Map Seamless Server website. USGS NED data is in conformance with the North American Datum of 1983 (NAD 83).

Previous WDNR modeling parameters for the incinerator (I08) were used for stack location, height, and diameter. However, for this modeling exercise, actual measured parameters from the December 2019 stack test were used for exhaust temperature, exit velocity, airflow and emission rate. Parameters can be found below in **Table 2**.

Table 2 – Modeling Input Parameters

Stack ID	Description	X	Y	Base Elevation	Height	Diameter	Rainhat	Exhaust Temp	Exit Velocity	Air Flow	Mercury
		meters	meters	meters	feet	feet	Y/N	F	m/s	acfm	lb/hr
I08	Fluid Bed Incinerator	420555	4931795.4	179.0	120	2.0	N	113.3	15.63	9,267	0.000646

Ambient air standards are not surpassed in this dispersion modeling demonstration. Modeling results are shown below in **Table 3**.

Table 3 – Modeling Results Compared to Table A Ambient Air Standards

	Averaging Period	Statistic / Metric	Modeled Concentration ($\mu g/m^3$)	NR 445 Ambient Air Standards ($\mu g/m^3$)	*% of NR 445*
Hg	24-hr	1st Highest	0.00187	*0.6*	*0.3%*
	Annual	1st Highest	0.00004	*0.3*	*0.01%*

Conclusions

The District can demonstrate compliance with NR 445.07(1) requirements. Uncontrolled mercury emissions from the incinerator do not surpass Table A, column (f) Thresholds for Emission Points or column (g) Ambient Air Standards.

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